A COMPARATIVE STUDY BETWEEN TWO DIFFERENT CURRENT STRENGTHS FOR SUPRACLAVICULAR BLOCK USING NERVE STIMULATOR IN ELECTIVE UPPER LIMB SURGERIES BELOW ELBOW

Dissertation submitted in partial fulfilment of

M.D. DEGREE EXAMINATION

M.D ANAESTHESIOLOGY – BRANCH X

CHENGALPATTU MEDICAL COLLEGE, CHENGALPATTU

THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY

CHENNAI, TAMILNADU.

APRIL 2017

CERTIFICATE BY THE HEAD OF THE INSTITUTION

This is to certify that the dissertation titled "**A Comparative Study Between Two Different Current Strengths For Supraclavicular Block Using Nerve Stimulator In Elective Upper Limb Surgeries Below Elbow"** is a record of bonafide work done by **Dr. Kanchana .G,** in the Department of Anaesthesiology, Chengalpattu Medical College, Chengalpattu during the academic year 2014 to 2017 under the guidance of **Dr. N. Basker, MD.,** Associate Professor and the supervision of **Prof**. **Dr. J. Revathy, M.D.D.A,** Professor and Head, Department of Anaesthesiology and submitted in partial fulfilment of the requirements for the award of M.D. Degree in Anaesthesiology in the April 2017 examination by The Tamilnadu Dr. MGR Medical University, Chennai. This work has not previously formed the basis for the award of a degree or diploma.

Date:

Place: Chengalpattu.

Prof. Dr. N.GUNASEKARAN, M.D,D.T.C.D.
Dean,
Chengalpattu medical college,
Chengalpattu.

CERTIFICATE BY THE HEAD OF THE DEPARTMENT

This is to certify that the dissertation titled "**A Comparative Study Between Two Different Current Strengths For Supraclavicular Block Using Nerve Stimulator In Elective Upper Limb Surgeries Below Elbow"** is a record of bonafide work done by **Dr. Kanchana. G,** in the Department of Anaesthesiology, Chengalpattu Medical College, Chengalpattu during the academic year 2014 to 2017, under my supervision and under the guidance of **Dr. N. Basker, MD.,** Associate Professor and submitted in partial fulfilment of the requirements for the award of M.D. Degree in Anaesthesiology in the April 2017 examination by The Tamilnadu Dr. MGR Medical University, Chennai. This work has not previously formed the basis for the award of a degree or diploma.

Date:

Place: Chengalpattu.

Prof. Dr. J. REVATHY, M.D,D.A.
Professor and Head,
Department of Anaesthesiology,
Chengalpattu Medical College,
Chengalpattu.

CERTIFICATE BY THE GUIDE

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Date:

Place: Chengalpattu

Prof. Dr. N. BASKER, M.D.,

Associate Professor,

Department of Anaesthesiology,

Chengalpattu medical college,

Chengalpattu.

DECLARATION BY THE CANDIDATE

I, **Dr. G. Kanchana**, hereby declare that the dissertation titled "**A Comparative Study Between Two Different Current Strengths For Supraclavicular Block Using Nerve Stimulator In Elective Upper Limb Surgeries Below Elbow**" was done by me in the Department of Anaesthesiology, Chengalpattu Medical College & Hospital, Chengalpattu after getting approval from the Ethical Committee, under the able guidance of **Dr. N. Basker, MD.,** Associate Professor and supervision of **Prof. Dr. J. Revathy, M.D**,**D.A**, Professor and Head, Department of Anaesthesiology, Chengalpattu Medical College.

This dissertation is submitted to the Tamilnadu Dr.MGR Medical University, Chennai towards the partial fulfilment of the requirement for the award of M.D. Degree in Anaesthesiology (Branch X) in the April 2017 examination.

I have not submitted this dissertation on any previous occasion to any University for the award of any degree.

Place: Chengalpattu

Date:

Dr. KANCHANA .G
Final year Post Graduate,
M.D. Anaesthesiology,
Chengalpattu Medical College &
Hospital, Chengalpattu.

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ETHICAL COMMITTEE CERTIFICATE

INSTITUTIONAL ETHICAL COMMITTEE

CHENGALPATTU MEDICAL COLLEGE, CHENGALPATTU

Title of Work	:	Comparison between two different current strengths For supraclavicular block using nerve stimulator in Elective upper limb surgeries below elbow
Principal Investigator	:	Dr.G.Kanchana
Designation	:	2nd Year Post Graduate in Anaesthesia
Co-Investigators	:	Dr.N.Basker,MD,. Associate Professor Department of Anaesthesiology
Department	:	Anaesthesiology

The request for an approval From the Institutional Ethical Committee (IEC) was considered on the IEC meeting held on 07.01.2016 at the Medical Education Unit, Government Chengalpattu Medical College, Chengalpattu at 11.00 PM.

The Members of the committee, the Secretary and the Chairman are pleased to approve the proposed work mentioned above, submitted by the principal investigator.

The Principal Investigator and their team are directed to adhere to the guidelines given below:

1. You should inform the IEC in case of any changes in study procedure, site, investigator investigation or guide or any other changes.
2. You should not deviate from the area of work for which you applied for ethical clearance.
3. You should inform the IEC immediately, in case of any adverse events or serious adverse reactions.
4. You should abide to the rules and regulations of the institution(s).
5. You should complete the work within the specific period and if any extension is required, you should apply for permission again and do the work.
6. You should submit the summary of the work to the ethical committee on complete of work.

MEMBER SECRETARY,
IEC, CHENGALPATTU MEDICAL COLLEGE
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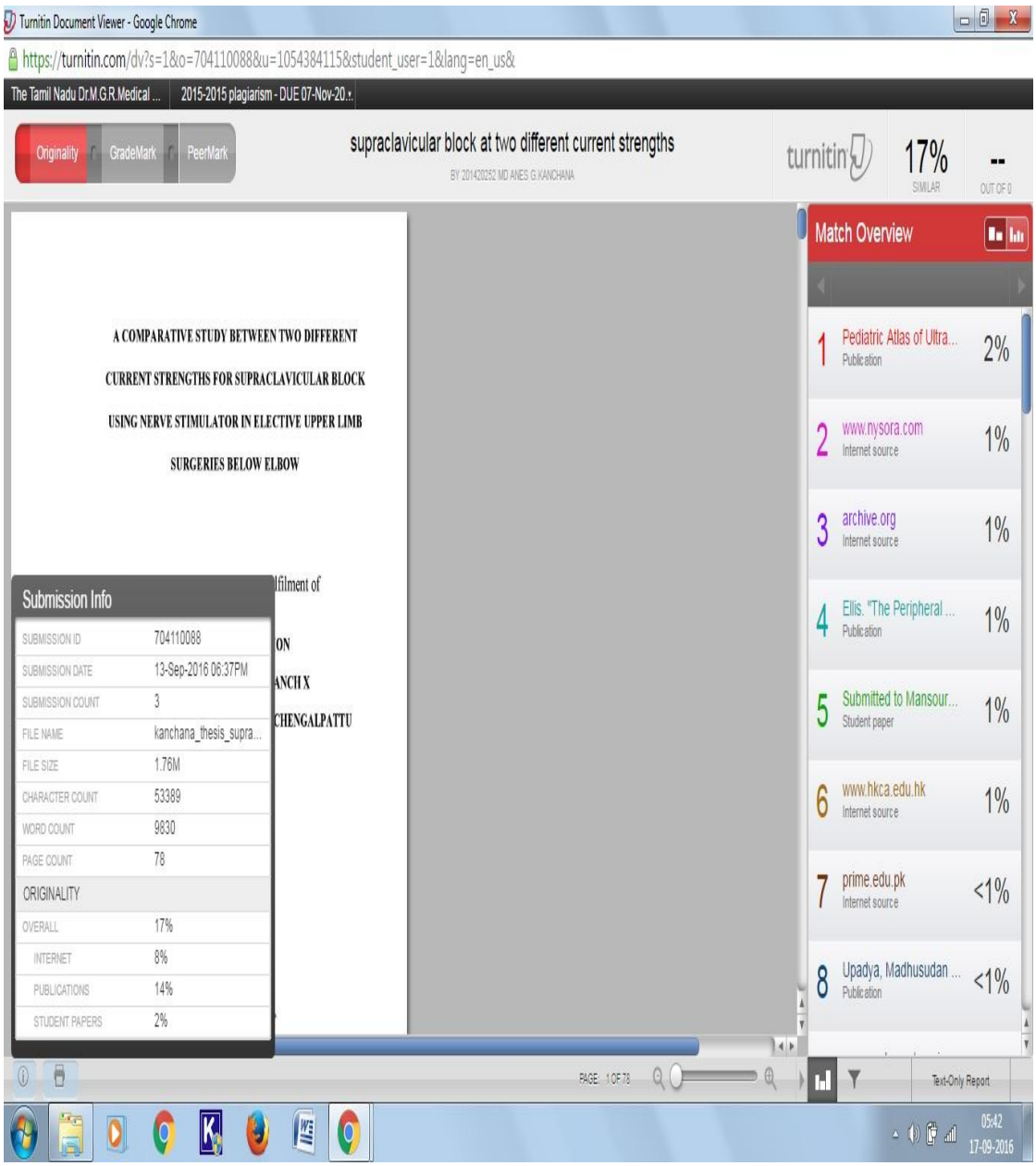
PLAGIARISM CERTIFICATE



CONTENTS

INTRODUCTION

Painless surgery is the ultimate goal for all anaesthesiologists and the heartfelt wish of all patients undergoing any type of surgery.

Regional anaesthetic technique like nerve blocks offer pain free surgical field during and after the intra operative period to patients with a lot of other advantages over general anaesthesia.

Nerve blocks allow the patient to stay awake maintaining their spontaneous breathing and offers protection against aspiration risk. Other complications of general anaesthesia like post operative nausea and vomiting, allergic reactions, hemodynamic alterations, excess sedation, malignant hyperthermia and the remote possibility of failed intubation, etc., are easily circumvented by peripheral nerve blocks. It can also be used in chronic pain management.

Early approach to nerve blocks followed the dictum of Moore which states *"No Paraesthesia; No anaesthesia"*[1]. The "art" of peripheral nerve blockade performed by gifted individuals has now turned into a "science" with the help of peripheral nerve stimulators and ultrasound imaging.

Peripheral nerve blocks anaesthetize superficial and deep structures allowing extensive surgical exploration. Blockade of sympathetic nervous system causes vasodilatation thereby improving blood supply to operated

limb. Postoperative analgesia is excellent and prolonged by inclusion of additives and by adapting continuous catheter techniques.

Brachial plexus blockade provides excellent analgesia and anaesthesia to patients for upper limb surgeries with reduced requirement of opioid analgesia thereby reducing hospital stay and cost when compared with general anaesthesia.

Brachial plexus blockade can be achieved by one of the following approaches

- ✓ Interscalene
- ✓ Supraclavicular
- ✓ Infraclavicular
- ✓ Axillary and
- ✓ Posterior paravertebral

Techniques for brachial plexus blockade include

- ➢ Landmark based paraesthesia elicitation
- ➢ Nerve stimulator guided
- ➢ Ultrasound guided
- ➢ Dual guided (USG and nerve stimulator)

The following excerpt is from the original paper by Von Perthes[2], the first person to describe nerve stimulator guided blocks:

"Following Kuhlenkampff's[3] *method, one injects above the clavicula; one knows that it hits the plexus when the patient tells the doctor that he feels it in his arm. It seems this is something the patient can do, but I realized that most patients are not able to do this. Some patients are so nervous and get so excited when the hives get attached that they are no longer able to express what they feel in their muscles. Sometimes, when the electric stimulus proved that the plexus was reached, the patient still claimed he/she did not feel anything. It seems more appropriate to use the objective method—the motoric stimulus—instead of depending on the word of the patient. Another advantage of this method is that one can put very nervous patients into a doze."*

This study is designed to make nerve stimulator guided technique better by comparing the quality of blockade when performed at two different current strengths of 0.5 and 0.9 mA.

AIM:

To study the quality of blockade while using two different current strengths for supraclavicular block with nerve stimulator in elective upper limb surgeries below elbow.

OBJECTIVES:

To comparatively evaluate the quality of blockade using 0.5 mA and 0.9 mA current strengths as the seeking current in supraclavicular block with nerve stimulator in below elbow surgeries with respect to

- Time taken to perform the block
- Number of attempts to perform the block
- Time of onset of sensory blockade
- Time of onset of motor blockade
- Total duration of sensory blockade
- Total duration of motor blockade
- Time taken for Rescue analgesia
- Complications.

HISTORY

HISTORY OF BRACHIAL PLEXUS BLOCKADE

Carl Koller's[4] experiments with cocaine for anaesthetizing the eye remains the crucial event in the evolution of regional blockade.

Brachial plexus block was first performed by William Halstead[5] and Alfred Hall[6] in 1884 by directly dissecting and exposing the nerves roots. George Crile[7] in 1897 also followed a similar approach.

Leonard Corning[8] noted that placing a tourniquet on the limb prolongs anaesthesia by reducing drug absorption. Heinrich.F.Braun[9] obtained the same effect by adding epinephrine which he named as the "chemical tourniquet".

First percutaneous technique was performed by G.Hirschel[10] in 1911 through axillary approach.

Kulenkampff[3] in 1911 introduced the classical supraclavicular approach after successful self injection with procaine. Subclavian perivascular technique was described by Winnie and Collins in 1964.[11, 12]

Infraclavicular approach was described by Bazy and Pauchet in 1911 and was later popularized by Raj in 1973[13]. Kappis[14] described posterior paravertebral approach in 1912 which had a high failure rate compared with the anterior approaches.

Winnie[15] also introduced the interscalene approach in 1970 for surgeries on shoulder and upper arm.

HISTORY OF NERVE STIMULATORS

Galvani[16] in 1780 described the effects of electrical neuromuscular stimulation.

Electrical nerve stimulator was first described by Von Perthes[1] in 1912. Insulated needles were introduced by Pearson[17].

Portable nerve stimulators were introduced by Greenblatt and Denson[18] in 1962.

Ford et al[19] in 1984 suggested the use of constant current source nerve stimulators.

Use of nerve stimulators became common only in the mid to late 1990s.

ANATOMICAL CONSIDERATIONS[20]

Brachial plexus provides the motor supply and major sensory supply to the upper extremities. Blockade of the plexus results in anaesthesia of the upper limb, the extent of which depends on the location where the block is being performed. Brachial plexus consists of

- ✓ Five roots,
- ✓ Three trunks,
- ✓ Six divisions,
- ✓ Three cords and
- ✓ Five major terminal nerves.

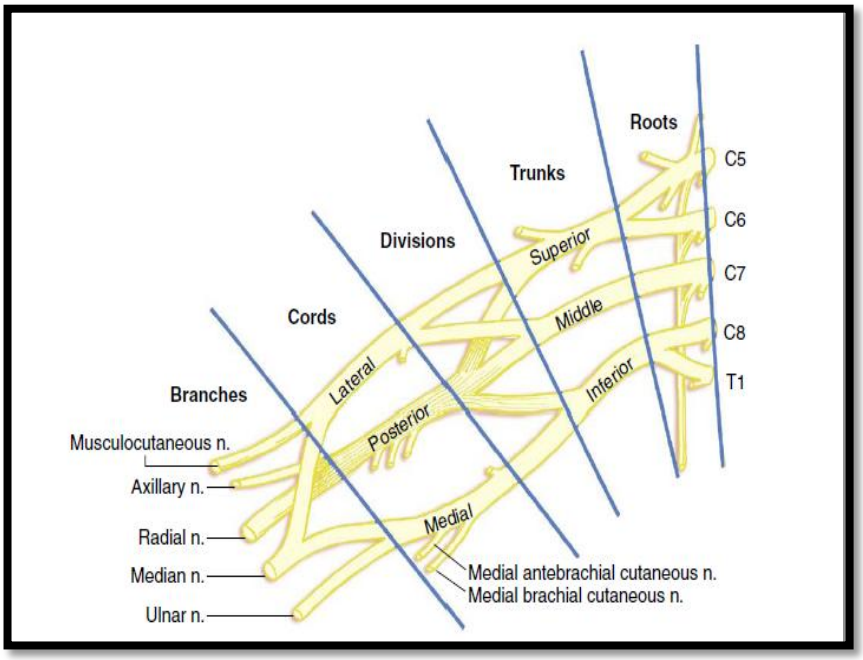
FORMATION

- Anterior primary rami of C5, C6, C7, C8 and T1.
- Occasional – contribution from C4 or T2 seen.
- Plexus may also be

  PRE FIXED (C4 to C8) or

  POST FIXED (C6 to T2).

BRACHIAL PLEXUS – SCHEMATIC DIAGRAM[21]



COURSE OF BRACHIAL PLEXUS

ROOTS

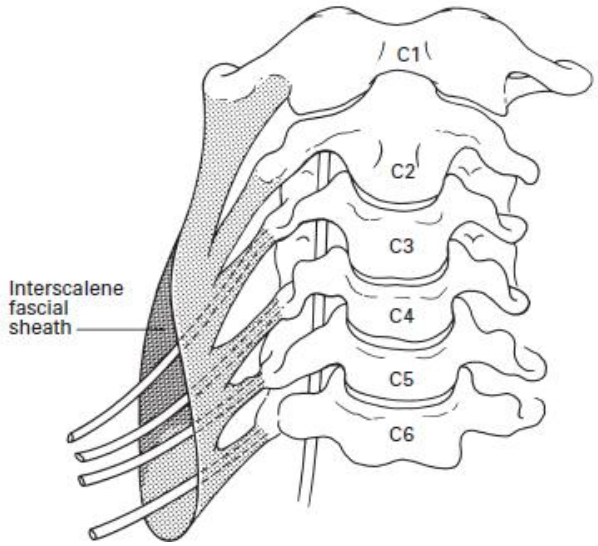
- Emerge through the intervertebral foramina.
- Each root passes behind the foramen transversorium of the corresponding cervical vertebra lying in the gutter between the anterior and posterior tubercles of the transverse processes.
- End up being sandwiched between the scalenus anterior and the scalenus medius muscles.
- Lie superior to second part of subclavian artery.
- The roots form the trunks at the level of the groove between scalenus anterior and scalenus medius muscles.

- *Upper trunk* – roots of C5 and C6
- *Middle trunk* – C7 root
- *Lower trunk* – roots of C8 and T1.

FIBRO FATTY SHEATH

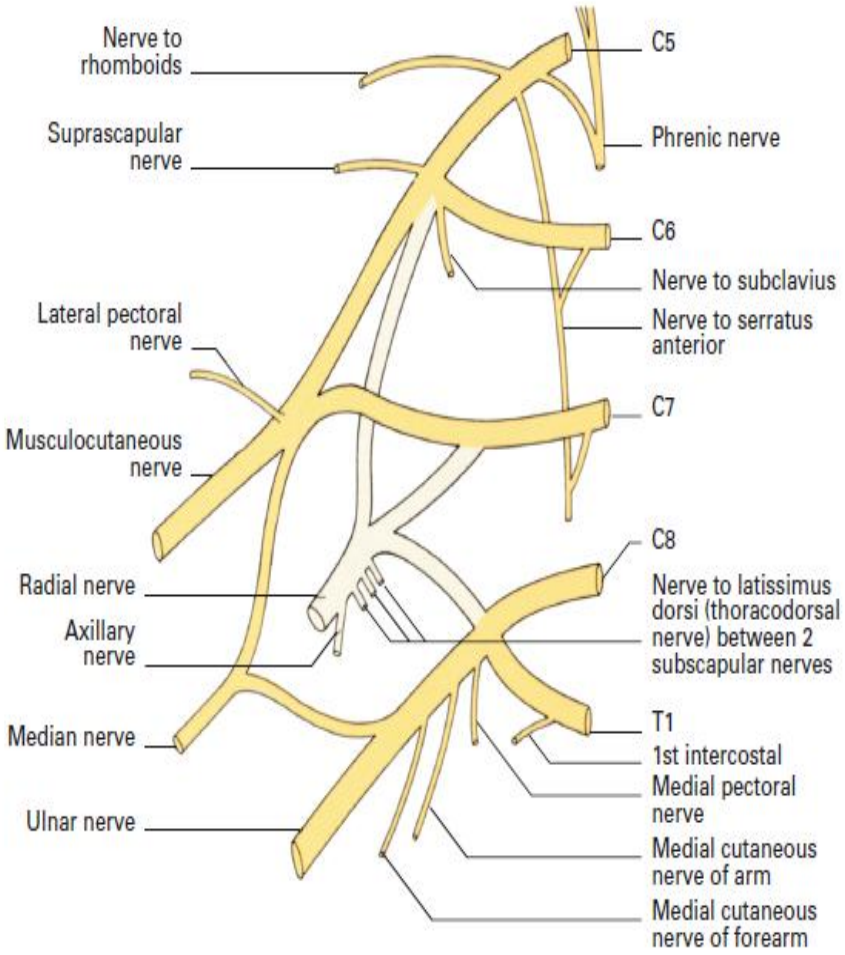
The nerve roots of the brachial plexus emerging as the trunks between the two scalene muscles are enveloped by a fibrofatty condensation of prevertebral fascia. The sheath also encloses the cervical plexus. The anterior layer of the sheath arises from the anterior tubercles and covers the posterior surface of scalenus anterior muscle. The posterior layer of the sheath arises from the posterior tubercles and covers the anterior surface of scalenus medius muscle. Laterally the sheath extends around the brachial plexus upto the axilla. Thus an injection exactly into this sheath will provide blockade of the brachial plexus.

ROOTS OF BRACHIAL PLEXUS WITH FIBROFATTY SHEATH[22]



The following picture depicts the various branches of the brachial plexus.

BRANCHES OF BRACHIAL PLEXUS[23]



TRUNKS

- As mentioned above, the three trunks emerge between the scalenus anterior and medius muscles. They pass across the base of posterior triangle of the neck and then across the first rib.
- In the posterior triangle, the plexus lies superficially covered by skin, platysma and deep cervical fascia.

- Upper and middle trunks lie above the subclavian artery whereas the lower trunk lies behind the artery.
- At the lateral border of the first rib, each trunk divides into an *anterior* and *posterior division*.
- Interscalene and supraclavicular blocks target the trunks of brachial plexus.

DIVISIONS

- The six divisions (3 anterior and 3 posterior) from each trunk lie behind the clavicle, subclavius muscle and suprascapular vessels.
- They enter the axilla and join to form the three cords (lateral, medial and posterior) named after their relation to the axillary artery.
- Infraclavicular block targets the divisions of brachial plexus.

CORDS

- Formed at the apex of axilla and are clustered around axillary artery.
- LATERAL CORD
    - Union of anterior divisions of upper and middle trunk.
    - Continues as musculocutaneous nerve.
    - Gives off the lateral root of median nerve.

- MEDIAL CORD
    - Anterior division of lower trunk.
    - Continues as ulnar nerve.
    - Gives off medial root of median nerve.
- POSTERIOR CORD
    - Posterior divisions of all three trunks.
    - Continues as axillary and radial nerves.

Axillary block targets the terminal nerves i.e, median, ulnar and radial nerves.

BRANCHES OF THE BRACHIAL PLEXUS

BRANCHES FROM ROOTS

- Receive Grey rami from cervical sympathetic chain
    - C5 and C6 from the middle cervical ganglion;
    - C7 and C8 from the inferior cervical ganglion;
    - T1 from the ganglion of T1
- To longus cervicis (C5 to C8)
- To scalene muscles (C5 to C8)
- To rhomboideus (C5)
- To serratus anterior (C5 to C7)
- To phrenic nerve (C5)

BRANCHES FROM TRUNK

- UPPER TRUNK – Nerve to subclavius (C5, C6)

  Suprascapular nerve (C5, C6)

BRANCHES FROM DIVISIONS – NIL

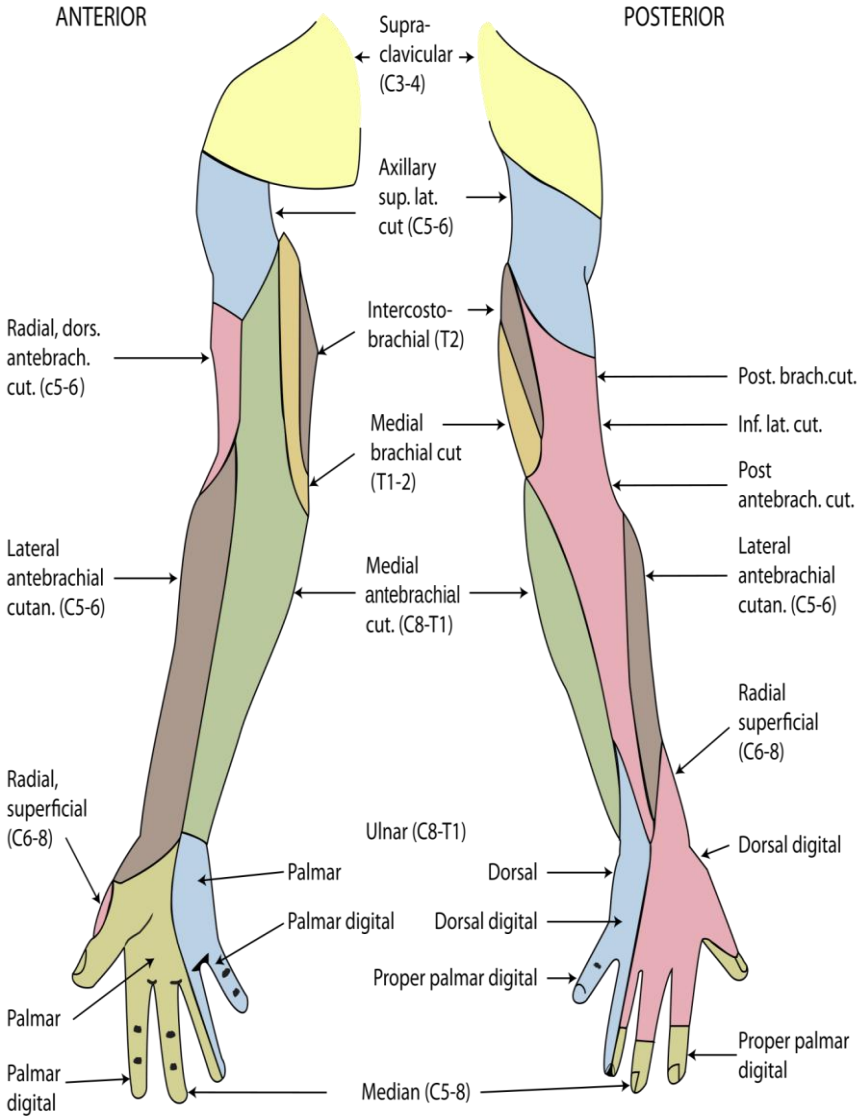
BRANCHES FROM CORDS

- LATERAL CORD
  - Lateral pectoral (C5 to C7)
  - Musculocutaneous (C5 to C7)
  - Lateral root of median (C5 to C7)
- MEDIAL CORD
  - Medial root of median (C8,T1)
  - Medial cutaneous nerve of arm (C8,T1)
  - Medial cutaneous nerve of forearm (C8,T1)
  - Medial pectoral nerve (C8,T1)
  - Ulnar nerve (C7,C8,T1)
- POSTERIOR CORD
  - Upper subscapular nerve (C5, C6)
  - Lower subscapular nerve (C5, C6)

- Nerve to lattisimus dorsi (C6, C7, C8)
- Axillary nerve (C5, C6)
- Radial nerve (C5 to C8, T1).

The following diagram shows the cutaneous innervations of the upper limb in both the anterior and posterior surfaces along with the dermatomal levels.

CUTANEOUS INNERVATION OF UPPER LIMB[24]



SUPRACLAVICULAR BLOCK

Supraclavicular block is aimed at the trunks and divisions of the brachial plexus. It is popularly termed as "spinal of the upper extremity"[25] owing to the dense blockade produced with a smaller volume of anaesthetic injected at a compact location of the plexus.

Advantages include rapid onset with reliable and complete anaesthesia of upper extremity including arm, elbow, forearm and hand.

There are various methods for performing this block like

- Landmark based blind technique eliciting paraesthesia
- Nerve stimulator guided
- Ultrasound guided
- Dual guided (nerve stimulator with ultrasound guidance)

The three trunks of the brachial plexus are clustered vertically over the first rib and cephaloposterior to the subclavian artery. The plexus can be palpated in lean individuals at the midpoint of the clavicle. The first rib acts as a barrier preventing needle piercing the pleura[26].

DISTRIBUTION OF BLOCKADE:

C5 to T1[27] dermatomal levels with anaesthesia and analgesia distal to shoulder including arm (except upper third), elbow, forearm, wrist and hands. There is sympathetic blockade in the same regions with increased temperature and loss of sweating.

POSITIONING OF PATIENT:

Patient is placed supine and the head is turned away from the side to be blocked. The arm to be blocked should be adducted with the shoulder pulled down, the forearm extended and supinated if possible and hand is kept as close to the ipsilateral knee as possible. A rolled towel can be placed between the shoulders along the spine to increase exposure of the area.

CLASSICAL TECHNIQUE:

- The midpoint of the clavicle is palpated and marked. The needle is inserted 1.5 to 2 cm posterior to this point.
- The point of needle insertion can be confirmed by palpating subclavian artery pulsation and entering just cephaloposterior to the pulsation.
- After aseptic skin preparation and developing a skin wheal with local anaesthetic solution, the anaesthesiologist stands at the patient's head end facing the patient.
- A 22 gauge, 4 to 5 cm short bevelled insulated needle is directed caudally, medially and posteriorly till paraesthesia (blind technique) or motor response (nerve stimulator technique) is elicited.
- If the first rib is contacted prior to any response, the needle is walked anteriorly and posteriorly over the rib till the plexus or subclavian artery is located.

- If subclavian artery is contacted, the needle is withdrawn slightly and inserted in a cephaloposterior direction.

- Once the plexus is located, after negative aspiration for blood, a total volume of 15 to 40 ml of local anaesthetic solution is injected in increments.

- If pain or undue pressure is noted during injection, the needle should be withdrawn 1 to 2 mm before reattempting the injection.

MODIFIED PLUMB – BOB TECHNIQUE[28]

- Similar patient positioning as classic technique.

- Needle should be inserted at the lateral border of sternocleidomastoid where it inserts on the clavicle.

- After skin asepsis and skin wheal with local anaesthetic, a 22 gauge 4 cm needle is inserted mimicking a plumb bob suspended over the needle entry site.

- Paraesthesia or motor response is elicited before contacting the subclavian artery or first rib.

- If no response is observed, the needle tip is withdrawn till skin and angulated slightly cephalad through an arc of 20 degrees and if still unsuccessful, needle tip is directed caudad through an arc of 20 degrees, till response is elicited and the injection is performed in small increments.

SUBCLAVIAN PERIVASCULAR TECHNIQUE (Winnie's)[11,12]

- The entry point for the needle is at the interscalene groove where the subclavian artery pulsation is felt.
- The lateral border of sternocleidomastoid can be palpated easily by asking the patient to lift their head off the pillow with head turned to opposite side. The interscalene groove can then be identified by rolling the fingers laterally.
- The needle is directed caudad to this point, tangential to the dorsal aspect of subclavian artery.

NERVE STIMULATOR BASED TECHNIQUE:

Positioning of the patient and anatomical landmarks are same as for blind technique. Subclavian artery is palpated 1 to 2 cm above the clavicle in the interscalene groove. A 22G bevelled insulated needle of around 4 to 6 cm length is inserted just cephaloposterior to the artery. The point of insertion should be almost perpendicular to the skin with a slight caudal orientation.

If the rib is contacted, anteroposterior needle adjustment with careful medial and lateral probing is done to locate the plexus. An initial current (seeking current) of 0.8 to 1 mA at 0.1 ms pulse duration and 1 Hz frequency is used to localize the nerve plexus.

The different nerve responses include the following muscle contractions:

- ✓ Pectoralis, biceps, deltoid (upper trunk)
- ✓ Triceps, forearm (upper, middle trunk)
- ✓ Hand, fingers (lower trunk)

Response from the lower trunk, which is twitching of fingers in flexion or extension, is desired with a reduced current strength of upto 0.4 mA. Following which, the needle is fixed and the local anaesthetic solution is injected in small increments after negative aspiration for blood each time. Responses at very low current strength of <0.4 mA, pain on injection and an injection pressure (if monitored) of >15 psi[29] is unacceptable and may indicate intraneural needle placement.

SUPRACLAVICULAR BLOCK – NEEDLE ENTRY POINT

POSITIVE RAJ TEST[30]

Following local anaesthetic injection, the motor twitching in nerve stimulator technique disappears due to displacement of needle tip from the vicinity of the plexus and also due to the blockade of the nerve fibres in proximity to the needle. However, recent studies show that this may be due to change in electrical field at the needle tissue interface as electrically conducting solutions like local anaesthetics reduce the current density at the needle tip.[31]

SIDE EFFECTS AND COMPLICATIONS:

- Pneumothorax 0.5 to 6% which reduces with experience. The pleural may be breached at the dome or the first intercostal space rarely. The first rib and the lateral edge of sternocleidomastoid serve as valuable landmarks to prevent this complication. Common in paediatric age group, COPD patients and tall, lean individuals. The needle should never cross medial to anterior scalene muscle to prevent pleural injury.
- Blockade of phrenic nerve with diaphragmatic paralysis 40 to 60%
- Nerve injury and neuropathy
- Horner's syndrome

Due to blockade of sympathetic ganglion leading to miosis, anhydrosis, nasal stuffiness, conjunctival injection, vasodilatation and feeling of warmth in the head and neck region of the side blocked.

- Arterial puncture and hematoma formation
- Accidental intra arterial injection leading to local anaesthetic systemic toxicity.

CONTRAINDICATIONS

- Patient refusal
- Skin infection at the site of block
- Coagulopathy and bleeding diathesis
- Uncooperative patients
- Bilateral surgeries at same time
- Anticoagulated patients
- Patients with known allergy to local anaesthetics.
- Contralateral pneumothorax
- Contralateral phrenic nerve palsy

PHYSIOLOGY OF NERVE STIMULATORS[30,32,33]

The series of experiments with an isolated nerve – muscle preparation conducted by Von Helmholtz[34] in 1850 proved the temporal nature of nerve conduction. These experiments lead to the advent of peripheral nerve stimulation techniques.

Electrical nerve stimulation is a method to identify peripheral nerves by using a low-intensity (upto 5 mA) and short-duration (0.05–1 ms) electrical stimulus (at 1–2 Hz frequency) to obtain a specific muscle twitch with an insulated needle.

Nerve stimulators deliver a low current electrical impulse to peripheral nerves in order to stimulate the motor fibres and thereby identify the proximity to nerves without actually stimulating sensory nerves which causes pain and discomfort to the patient. They identify nerves without making real contact with them.

During initial needle placement, the nerve stimulator delivers a current of 1 to 2 mA and after obtaining desired muscle twitch, the current strength is reduced to 0.3 to 0.5 mA. Then, the local anaesthetic is injected in divided doses. Response obtained at very low current strength of <0.3 mA indicates intraneural / intrafascicular injection.

Nerve stimulators can be used to perform single shot blocks and continuous catheter infusions. It is often combined with ultrasound guided technique to make sure that the structure visualised is actually nerve.

ELECTROPHYSIOLOGY OF NERVE CONDUCTION

Neurons have a voltage potential across their cell membranes at rest termed as the "resting membrane potential" around -90 mV. When this potential is reduced to around -55 mV by depolarization, an action potential develops once a threshold potential is reached. A series of such action potentials result in impulse conduction along the nerve fibre.

Nerve fibres are classified according to their diameter and myelination into the following types[35]

Fiber Class	Subclass	Myelin	Diameter (µm)	Conduction Velocity (msec)	Location	Function	Susceptibility to Local Anesthetic Block
A	α	+	6-22	30-120	Efferent to muscles	Motor	++
	β	+	6-22	30-120	Afferent from skin and joints	Tactile, proprioception	++
	γ	+	3-6	15-35	Efferent to muscle spindles	Muscle tone	++++
	δ	+	1-4	5-25	Afferent sensory nerves	Pain, cold temperature, touch	+++
B		+	<3	3-15	Preganglionic sympathetic	Various autonomic functions	++
C	sC	-	0.3-1.3	0.7-1.3	Postganglionic sympathetic	Various autonomic functions	++
	dC	-	0.4-1.2	0.1-2.0	Afferent sensory nerves	Various autonomic functions Pain, warm temperature, touch	+

These characteristics determine the threshold and speed of nerve conduction in the nerve fibres. Aα motor fibres with largest diameter and

degree of myelination have the least threshold for stimulation with the highest speed of conduction as compared with the Aδ and C fibres which conduct pain. Hence it is possible to stimulate the motor fibres without causing pain or discomfort to the patient.

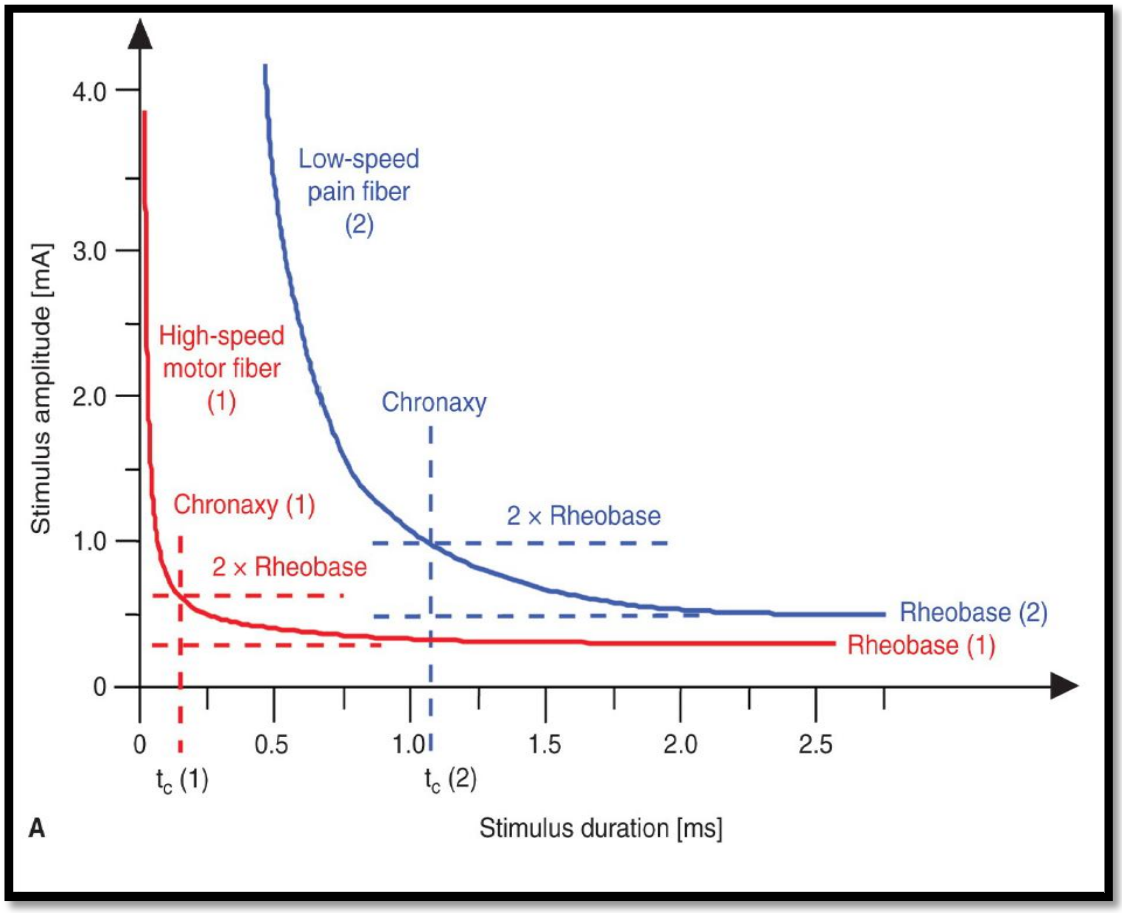
At a given pulse duration, nerve fibres need a certain minimum current intensity to reach the **threshold level** of excitation. The lowest threshold current to stimulate a nerve is **rheobase.** The pulse duration at double the strength of the rheobase current is called **chronaxy.**

Electrical pulses of chronaxy duration are the most effective ones to create action potentials in nerves. Therefore, motor responses can be elicited at short pulse duration (e.g., 0.1 ms) by nerve stimulators at relatively low current amplitudes whereas the stimulation of C-type pain fibers can be avoided at the same time.

Typical chronaxy figures are as follows:

NERVE FIBRE TYPE	CHRONAXY
Aα fibers	50 to 100 μs
Aδ fibers	170 μs
C fibers	≥ 400 μs

CHRONAXY AND RHEOBASE FOR MOTOR AND PAIN FIBRES[36]



During nerve stimulation, the negative pole of the cable (**cathode) is connected to the needle** and the positive pole (anode) is connected to the patient's skin as grounding electrode through ECG electrode. This **cathodal preference**[32] will easily trigger an action potential because the current flowing towards the needle produces an area of depolarization adjacent to the needle.

If the anode is connected to the needle, the current flowing away from the needle produces an area of hyperpolarization adjacent to the needle. An electrical circuit is formed by the nerve stimulator, the nerve block needle and tip, the skin and tissues of the patient, the skin or grounding electrode and the

cables connecting all of these elements. The resistance offered by the different elements and their interplay is complex necessitating a nerve stimulator which can deliver a constant current by self adjusting its voltage according to the tissue resistance. Shorter impulse duration with higher frequency results in better nerve stimulation.

The intensity of the current required to stimulate the nerve is based on Coulomb's law which states $E = K (Q / r^2)$ where E is current required, K is a constant, Q is the minimal current and r is the distance from the nerve. This law shows that at distances far from the nerve, very high current is required to stimulate the nerves and vice versa.

DESIRABLE FEATURES IN NERVE STIMULATORS

Galindo et al[37], Ford and Raj et al[33] and Kaiser et al[38] have recommended the following features

- An adjustable constant current source with high internal resistance to adjust according to tissue impedance and deliver accurate current.
- A precisely adjustable stimulus amplitude.
- A large and easy to read digital display of current strength delivered to enable the easy assessment of needle to nerve distance.
- A selectable pulse width duration. Shorter pulse width of 50 to 100 µsec is ideally used.
- A selectable stimulus frequency (1 to 3 Hz).

- A rectangular monophasic output pulse.
- Configurable start up parameters.
- An automatic self test to warn if the machine is faulty.
- A remote control (optional).
- Clear identification of output polarity.
- Battery operation to avoid risk of electrical burns
- Warning sign for circuit disconnection / low battery / high impedance / internal malfunction.

PHARMACOLOGY[39,40,41,42]

LOCAL ANAESTHETICS

These are agents which produce blockade of impulses along nerves on injection. Local anaesthetics block autonomic, somatic sensory and somatic motor nerve fibres with progressive increase in concentrations. The effects produced by these drugs are totally reversible upon their removal from the vicinity of the nerves.

MECHANISM OF ACTION

Local anaesthetics bind to specific receptor sites of voltage gated sodium (Na^+) channels on the nerve membranes. These sodium channels are responsible for conduction of impulses along nerves because opening of these channels cause depolarization of nerves.

Depolarization generates small electrical currents which sequentially depolarizes adjacent nerve segments. Local anaesthetics have a lipophilic and hydrophilic domain linked by amide or ester linkage.

The lipophilic domain is an unsaturated aromatic ring which is responsible for the clinical action of the drug. The hydrophilic domain is a tertiary amine such as diethyl amine.

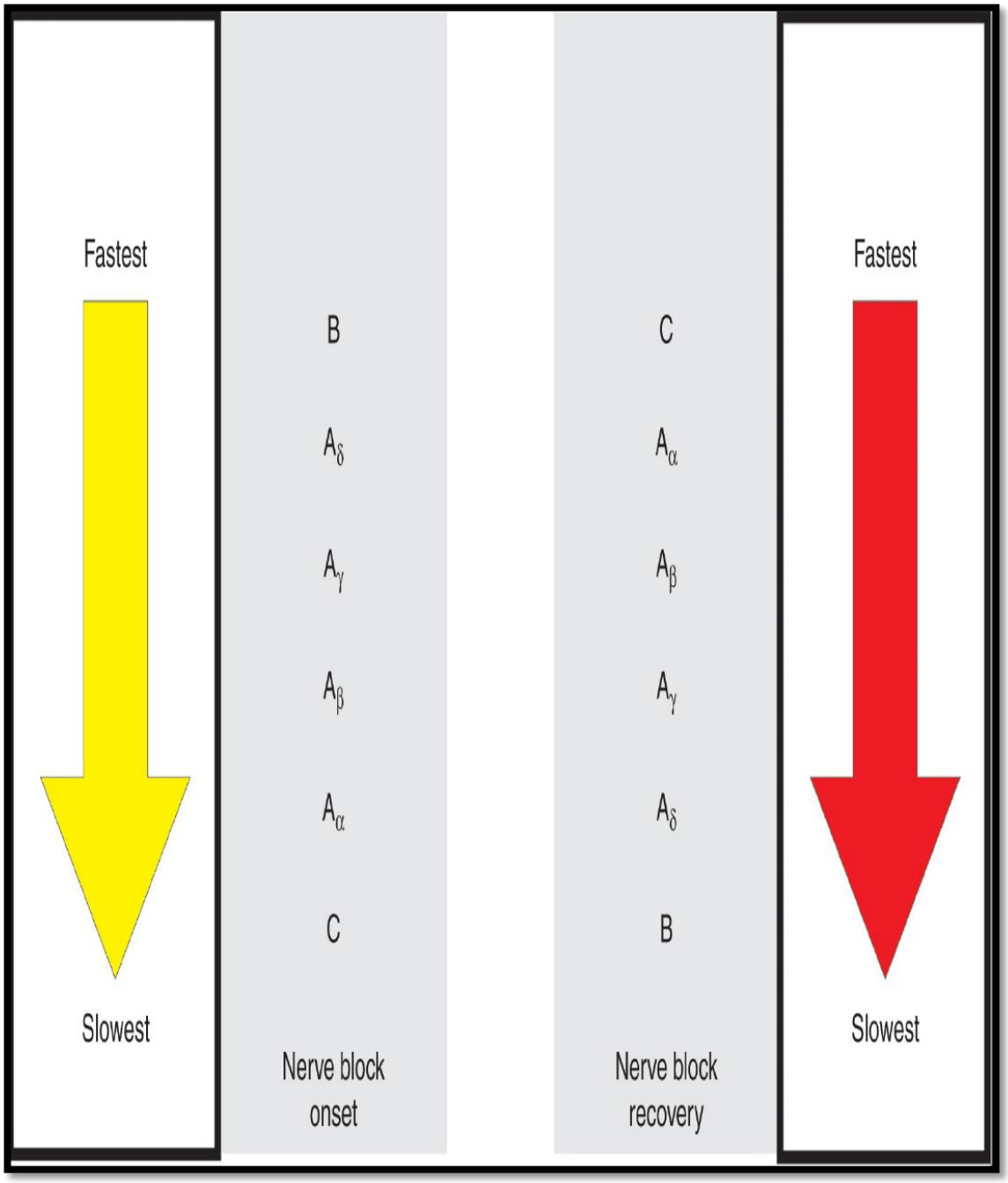
The sodium channels exist in three states:

- Resting – closed state with no sodium conductance. Local anaesthetics show less affinity to this state.
- Open – active state with high sodium conductance resulting in membrane depolarization. Local anaesthetics avidly enter the nerve membrane in this state and dissociate more slowly. Hence the amount of blockade depends on firing rate (frequency) and the voltage across the nerves.
- Inactive – closed state which is the precursor to the resting state. Local anaesthetics keep the channel blocked in this state, thereby preventing the conversion to resting state which in turn prevents the channel to become open and active to produce depolarization. Hence, no action potential will be developed at the nerve membrane with absence of resultant nerve conduction.

DIFFERENTIAL BLOCKADE:

Different fibre types in nerves are affected differently by local anaesthetics. In vivo experiments show that axons which are small and myelinated (Aγ motor and Aδ sensory fibres) are most sensitive to impulse blockade. Next susceptible nerves are large myelinated axons (Aα and Aβ fibres). The least susceptible axons are C fibres which are small and unmyelinated.

DIFFERENTIAL BLOCKADE BY LOCAL ANAESTHETICS[43]



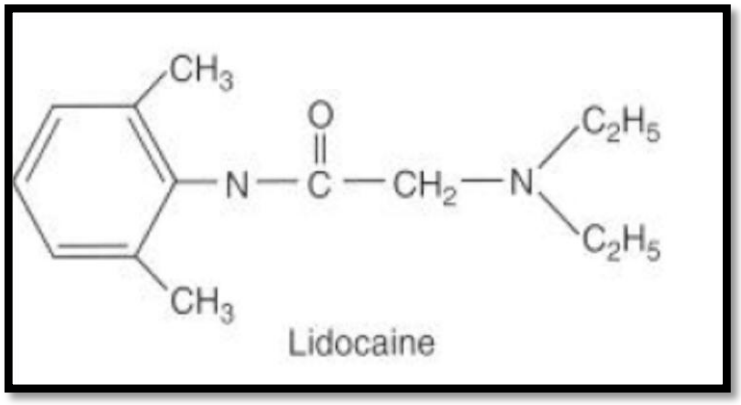
The pain sensation is the first to disappear followed by sensation of cold, warmth, touch, pressure and finally loss of motor function occurs.

LIGNOCAINE

It is an amide local anaesthetic synthesized by Lofgren in 1943 in Sweden. Lignocaine produces rapid and intense nerve blockade and also has an antiarrhythmic effect.

It is chemically diethyl aminoacetyl 2,6 xylidine hydrochloride monohydrate. It is available commercially as hydrochloride salt solution.

MOLECULAR STRUCTURE OF LIGNOCAINE



Lignocaine blocks the Na+ channels in inactive closed state and prevents impulse transmission. It is stable at room temperature. Vasoconstrictors like adrenaline prolong the duration of its effect with reduced systemic toxicity by reducing systemic absorption.

MAXIMUM SAFE DOSE

Safe dose is 4.5 mg/kg without adrenaline and 7 mg/kg with adrenaline. Blood concentration of lignocaine is highest after intercostal block followed by epidural, brachial plexus block and local infiltration in that order.

PHARMACOKINETICS

Molecular weight	271
Pk_a	7.8
Protein binding	64%
Lipid solubility	366
Volume of distribution	1.3 l /kg
Clearance	0.85 l / kg / hour
Elimination half life	96 minutes
Toxic plasma level	>5 µg/ml

METABOLISM

The major metabolic pathway is oxidative dealkylation in liver to monoethyl glycine xylidide followed by hydrolysis to xylidide. Thus liver disease can impair metabolism of lignocaine.

TOXICITY

- Allergic reactions – due to antibody stimulation by the preservatives (methyl paraben).
- CNS effects – may range from simple complaints like tongue and circumoral numbness, restlessness, vertigo, tinnitus, slurred speech,

skeletal muscle twitching to more dangerous features like tonic clonic seizures, CNS depression, hypotension and apnea. Initially there is inhibition of inhibitory neurons with resultant unopposed CNS excitation followed by inhibition of both inhibitory and excitatory neurons. Reports of transient neurological symptoms and cauda equina syndrome have been made with spinal lignocaine.

- CVS effects – profound hypotension due to arteriolar relaxation and direct myocardial depression can occur with high plasma levels.

LIGNOCAINE TOXICITY AND BLOOD LEVELS[44]

DOSE-DEPENDENT EFFECTS OF LIDOCAINE

Plasma Lidocaine Concentration (μg/ml)	Effect
1–5	Analgesia
5–10	Circumoral numbness
	Tinnitus
	Skeletal muscle twitching
	Systemic hypotension
	Myocardial depression
10–15	Seizures
	Unconsciousness
15–25	Apnea
	Coma
>25	Cardiovascular depression

TREATMENT OF TOXICITY

Seizures are managed by protecting the airway, providing 100% oxygen and intravenous agents like thiopentone 1 to 2 mg/kg, midazolam and propofol. If cardiac arrest occurs, ACLS guidelines are followed.

THERAPEUTIC USES

- ✓ Topical anaesthesia – EMLA cream (Lignocaine 2.5% with prilocaine 2.5%)
- ✓ Local infiltration and peripheral nerve blocks
- ✓ Intravenous regional anaesthesia
- ✓ Spinal / epidural
- ✓ Prevention of stress response eg, during intubation
- ✓ Treatment of ventricular dysrhythmias.

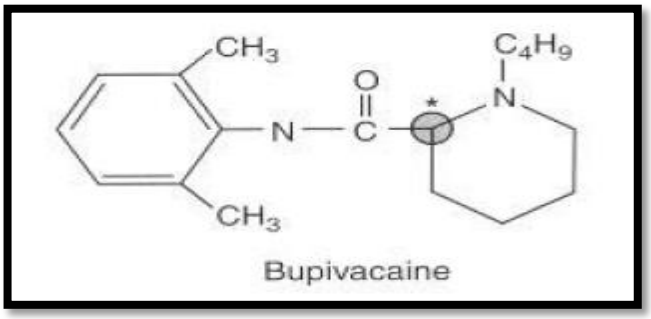
BUPIVACAINE

It is a long acting amide local anaesthetic synthesised by B.A.F Ekenstan in 1957. It was first used clinically by Talivuo and Widman in 1963.

Structure is similar to lignocaine except that the amine containing group is butyl piperidine. Levo – bupivacaine, the S enantiomer is also available with less cardiotoxicity.

It is available commercially as hydrochloride salt.

CHEMICAL STRUCTURE OF BUPIVACAINE



Bupivacaine is chemically 2-piperidinecarboxamide, 1-butyl-N-(2, 6-dimethyl phenyl)-, mono hydrochloride, mono hydrate.

It has the property of sensory – motor dissociation, which is for the given degree of sensory blockade, motor blockade is lesser when compared to lignocaine. Thereby, bupivacaine produces longer duration of sensory block with less intense motor block.

PHARMACOKINETICS

Molecular weight	288
Pk_a	8.1
Protein binding	95%
Clearance	0.41 l/ kg / hour
Volume of distribution	1.02 litres/kg
Lipid solubility	3420
Elimination half life	Adults 2.7 hours and neonates 8.1 hours
Toxic plasma concentration	>3 µg/ml

METABOLISM

Bupivacaine is metabolised in the liver by enzymes through aromatic hydroxylation, N – dealkylation, amide hydrolysis and conjugation. Metabolite is N – dealkylated desbutyl bupivacaine.

MAXIMUM SAFE DOSAGE – 3 mg/kg

EXCRETION

Bupivacaine is excreted mainly through the kidneys. Only 5% is excreted unchanged in urine.

CLINICAL USES

- ✓ Central neuraxial blockade (spinal, epidural, caudal)
- ✓ Peripheral nerve blocks
- ✓ Infiltration analgesia

TOXICITY

More cardiotoxic than lignocaine. Toxicity manifests as ventricular and myocardial depression after accidental intravascular injection. Bupivacaine dissociates more slowly from cardiac sodium channels than lignocaine which results in more channels being blocked during diastole. Toxicity is enhanced by acidosis, hypoxemia and hypercarbia.

TREATMENT OF TOXICITY

- ✓ Cardiopulmonary resuscitation
- ✓ Rapid intravenous bolus of Intralipid 20% (1.5 ml/kg) to be administered without delay followed by infusion of 0.25 ml/kg/min for the next 10 minutes.

ADRENALINE

Vasoconstrictor substance like adrenaline is commonly used with local anaesthetics to increase the duration of action by delaying absorption and to decrease the incidence of systemic toxicity by lowering peak blood level.

Though its use in microvascular reimplantation and reconstructive surgeries of hand is controversial due to possible decreased overall arm blood flow, it was used in this current study to reduce the incidence of toxicity due to lignocaine.

Adrenaline (epinephrine) is the prototype drug among sympathomimetics. Has agonistic effect at adrenergic α, β_1 and β_2 receptors. It is poorly lipid soluble and hence has no CNS effects.

Its functions are

- Regulation of myocardial contractility, heart rate, tone of vascular and bronchial smooth muscles.
- Regulation of glandular secretions and metabolic processes.

USES

- To prolong duration and decrease toxicity of local anaesthetics.
- Treatment of anaphylactic reactions.
- Cardiopulmonary resuscitation.
- Continuous infusion to improve myocardial contractility.

REVIEW OF LITERATURE

1. The Supraclavicular Block with a Nerve Stimulator: To Decrease or Not to Decrease, That Is the Question[45]

Carlo.D.Franco et al compared the characteristics of supraclavicular block performed at 0.5mA (Group 1) and 0.9mA (Group 2) after observing motor twitch of fingers in 60 patients. The authors tried to "compare 0.5 and 0.9 mA not as minimum stimulating currents but rather as currents which elicited an unmistakable motor twitch." One patient was excluded from the study. The success rate for the block in the remaining 59 patients of both the groups was 100%.

They found that the onset of analgesia was 2.1± 0.4 and 2.5±1.3 minutes in each group. The onset of anaesthesia was in 10.9 ±5.4 minutes (Group 1) and 11.4±4.8 minutes (Group 2) and the duration of anaesthesia was 266±38 minutes (Group 1) and 272±44 minutes (Group 2) respectively with no complications.

They concluded that eliciting a "clearly visible twitch of fingers at 0.9 mA can be followed by injection of local anaesthetic solution." Also, decreasing the current strength to 0.5mA produced no improvement in the overall quality of the block as shown by the similar onset and duration of analgesia / anaesthesia and satisfaction score of patients.

2. Vertical infraclavicular block with local anaesthetic injections at different currents.[46]

Aghdashi et al studied the quality of vertical infraclavicular block performed using nerve stimulator at 0.8 mA (study group) and 0.5 mA (control group). The onset of analgesia occurred in 4.3 minutes and 4.6 minutes in study and control group. The onset of anaesthesia occurred in a mean duration of 15.6 and 13.5 minutes in study and control groups (p = 0.064). They concluded that injection at seeking current (0.8 mA) produces a similar quality of block when compared with injection at 0.5 mA.

3. The relationship between current intensity for nerve stimulation and success of peripheral nerve blocks performed in pediatric patients under general anesthesia.[47]

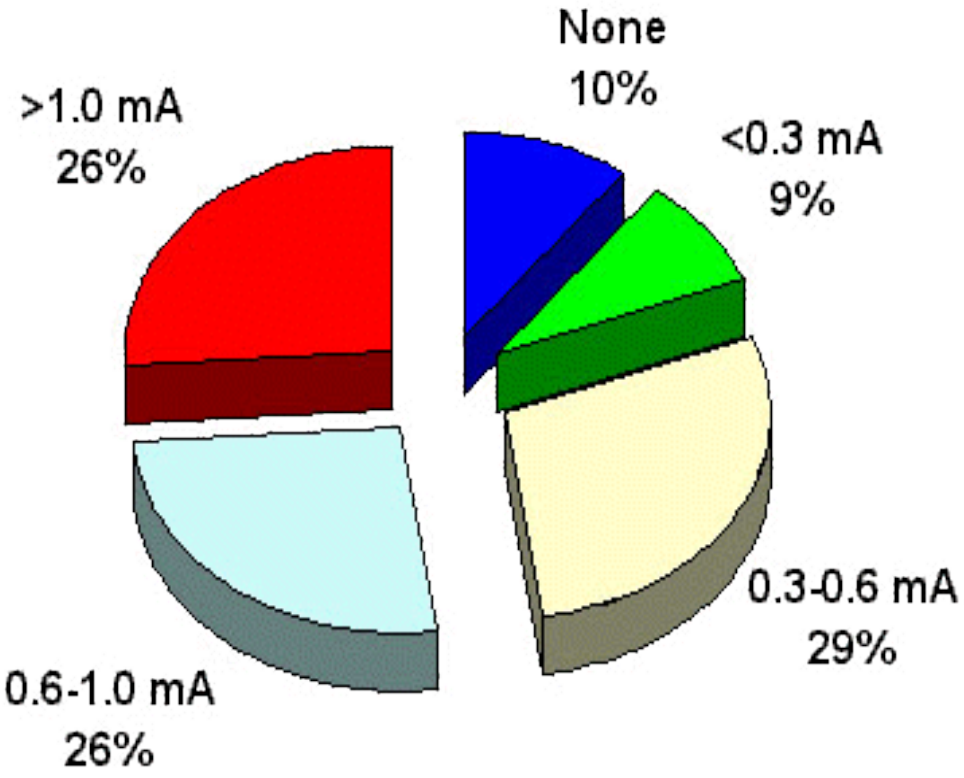
Gurnaney H et al retrospectively compared the relationship between current strengths to elicit motor response before performing nerve blocks in pediatric patients under general anaesthesia. 666 patients had received peripheral nerve blocks during the period studied.

All blocks were performed at current strengths ranging from 0.2 to 1 mA. The overall success rate was 96% and there was no difference in success rate between blocks performed at <0.5 mA or =0.5 mA or >0.5 mA (p value of 0.793).

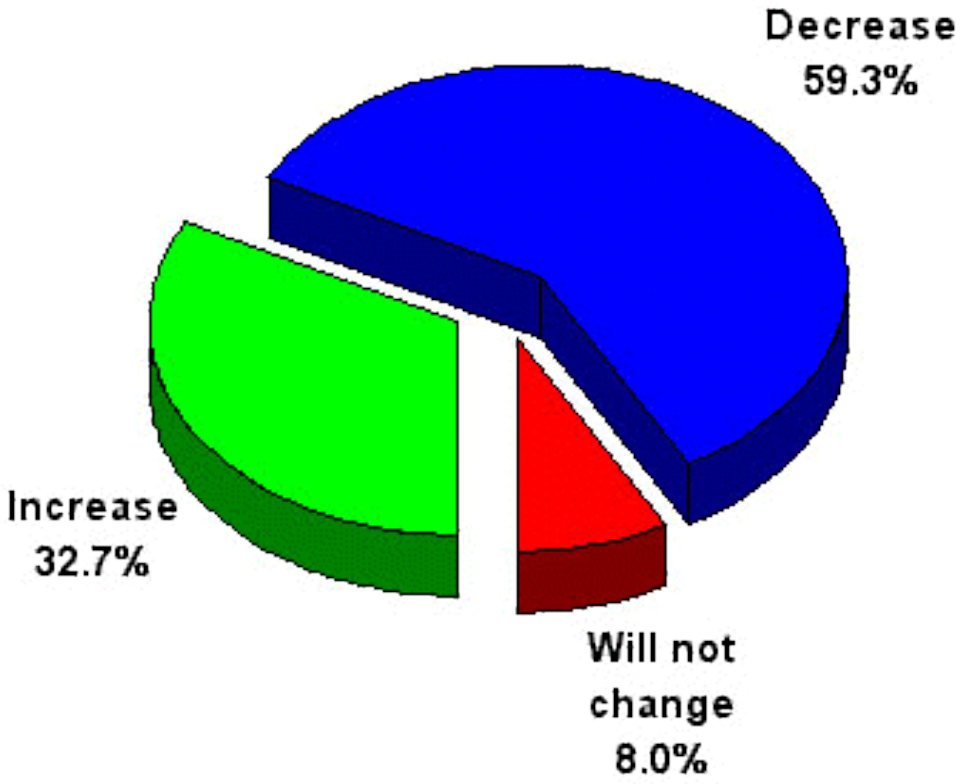
They concluded that it may be unnecessary to manipulate the needle to obtain response at lower current strength as it may cause increase in intraneural injection.

4. A National Survey on Practice Patterns in the Use of Peripheral Nerve Stimulators in Regional Anesthesia[48]

Vloka JD et al conducted a survey through questionnaires sent to 413 practising anaesthesiologists in the United States. 268 of them used peripheral nerve stimulators for performing blocks. The initial current setting used by these anaesthesiologists is shown in the pie diagram below:



Anaesthesiologists performing more nerve blocks each month tended to adjust the current strength more before injecting local anaesthetics as shown in the following pie diagram:

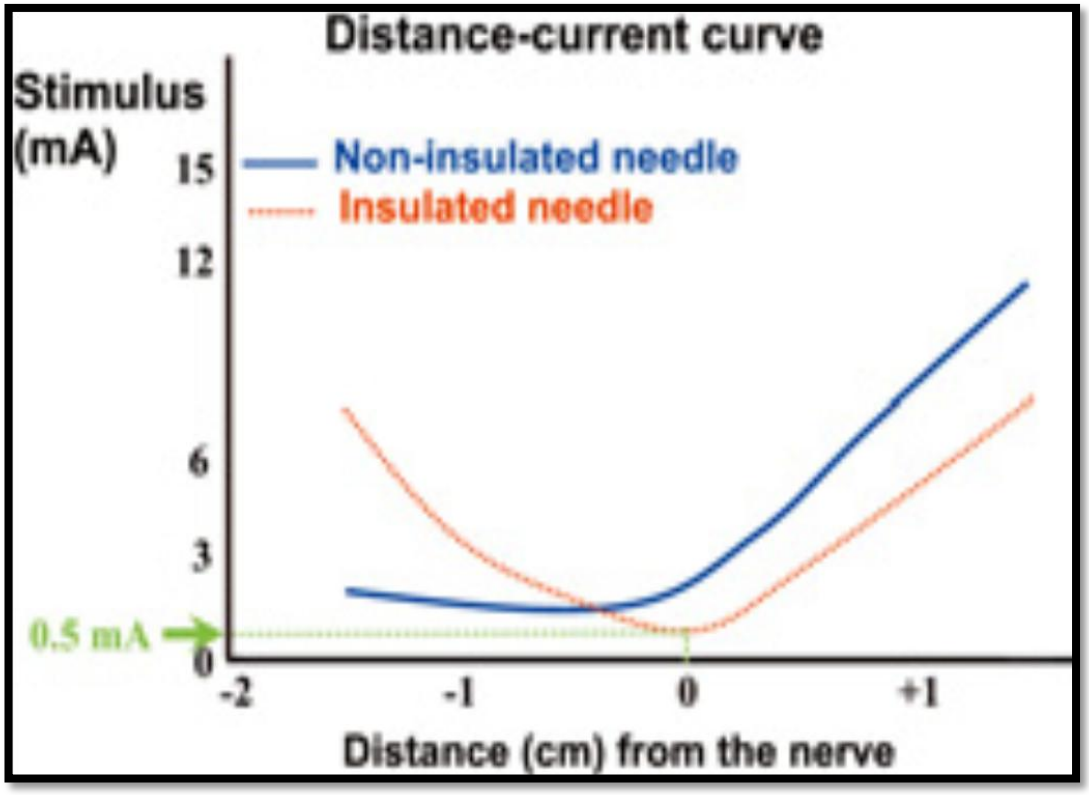


5. The use of peripheral nerve stimulation for regional anaesthesia: A review of experimental characteristics, technique and clinical applications[32]

Pither et al conducted a series of experiments regarding the properties of nerve stimulators and the current intensities required to stimulate the nerves

They found that a very high current is required when the needle tip is far away from the nerve being stimulated.

Uninsulated needles required higher currents when compared to insulated needles at the same distance from the nerves as shown in the following graph:



6. Comparison of insulated and uninsulated needles for locating p eripheral nerves with a peripheral nerve stimulator.[49]

Ford et al designed a study to compare insulated and uninsulated needles with peripheral nerve stimulators for locating peripheral nerve in anaesthetized cats. "The needles were mounted on a one-dimensional manipulator and the saphenous and sciatic nerves were located."

They noted that the nerve stimulation with minimum current of 0.57 ± 0.26 mA occurred when the tip of insulated needle was on the nerve but at 0.1 to 0.9 cm past the nerve, stimulation occurred at 1.33 ± 0.38 mA when uninsulated needle was used. They concluded that insulated needles locate the nerves precisely than uninsulated needles.

7. Obturator nerve block: an evaluation of technique[50]

Magora et al compared 14 obturator nerve blocks in 8 patients by blind anatomical approach, fluoroscopic guidance and electrical stimulation. They found that nerve stimulation at 0.5 mA rheobase was the best techniques to locate the nerve. If current strength of 1 to 3 mA was used, the block was ineffective.

8. Nerve stimulator polarity and brachial plexus block.[51]

Tulchinsky et al conducted a randomized double blinded study in 10 patients undergoing axillary block. They determined the minimum current strength to obtain maximal response with positive and negative polarity. They observed that higher current strength was required with positive needle polarity (1.49 ± 0.49 mA) when compared with negative needle polarity (0.47 ± 0.15 mA). Hence, use of positive needle may lead to either abandonment of block or inadvertent vascular puncture and neural contact.

9. Intraneural injection with low-current stimulation during popliteal sciatic nerve block.[52]

Robards C et al studied 24 consecutive sciatic nerve blocks in patients undergoing foot or ankle surgeries using a combined ultrasound and nerve stimulator guided technique.

The endpoint for injection was obtaining motor response at 0.2 to 0.4 mA or intraneural location of needle tip as seen on ultrasound whichever occurred first.

Motor response was obtained only in 20 patients. In the other 4 patients, motor response was not obtained even at 1.5 mA though the needle was found intraneurally in ultrasound imaging. At the current of 0.2 to 0.4 mA, intraneural injection occurred in all patients. The success rate was 100% in all 24 patients.

They concluded that absence of motor response does not exclude intraneural needle placement and resulted in unwanted needle manipulations. Low stimulation currents are associated with frequent intraneural needle placement.

Therefore, blocks performed at current strengths of >0.6 mA but <1 mA will prevent the accidental intraneural injections.

10. Intraneural injection during nerve stimulator-guided sciatic nerve block at the popliteal fossa.[53]

Sala Blanch X et al tested the hypothesis that "intraneural injection occurred commonly with nerve stimulator guided popliteal sciatic nerve block."

They performed popliteal sciatic block in 44 patients posted for hallux valgus repair when they obtained motor response at <0.5 mA currant.

Ultrasound imaging was done before and after the block to measure the sciatic nerve dimensions.

Intraneural injection was defined as increase in nerve area by < or =15% and one of the following ultrasound image findings: nerve swelling with fascicular separation or proximal/distal diffusion of drug within epineurium.

Post injection increase in area was found in 32 patients. Nerve swelling was seen in 37 patients and proximal/distal diffusion was seen in 6 out of 14 patients. Intraneural injection criteria was met in 28 patients (66%). Greater increase in nerve area was observed in patients with faster block onset. None of the patients developed neurological complications during the post operative period.

11. Comparison of 3 intensities of stimulation threshold for brachial plexus blocks at the midhumeral level: a prospective, double-blind, randomized study.[54]

Cuvillon et al compared the success rate and onset time between <0.5 mA, 0.5 to 0.64 mA and 0.65 to 0.8 mA while performing nerve stimulation guided blocks at midhumeral level.

69 patients undergoing hand surgery were given neurostimulation guided blocks at midhumeral level. Injections were performed when motor response was obtained only at the above mentioned current strengths and not more or less than the desired current.

All patients received 0.75% ropivacaine 8 ml for the 4 nerves (radial, median, ulnar and musculocutaneous). They observed that the time to perform the block was similar at 17, 13 and 13 minutes in each group.

The time required to obtain complete sensory block was faster in <0.5 mA group with complete blockade. Group >0.65 mA required more general anaesthesia conversion. They concluded that lower intensity provides faster onset and successful block.

12. Influence of femoral catheter stimulation intensity on post-surgical analgesia after total knee replacement.[55]

Ortiz de la Tabla Gonzalez et al studied the adequacy of post op surgical analgesia with different neurostimulation intensities with stimulating catheters at femoral nerve level after total knee arthroplasty under subarachnoid anaesthesia.

Continuous femoral block was performed in 124 patients with stimulating catheters at 0.2 to 0.5 mA in group 1, 0.6 to 1 mA in group 2, ≥1.1 mA in group 3 and blind placement at 3 to 5 cm depth in group 4. They found no statistically significant difference in the four groups with regard to the sensory block in femoral area at 48 hours (p value of 0.019), rescue analgesia requirements, patient satisfaction and undesirable effects.

They concluded that no influence was found on the level of analgesia between different neurostimulation intensities with stimulating catheters.

13. Electric nerve stimulation in relation to impulse strength. A quantitative study of distance of electrode point to the nerve.[56]

Neuburger et al studied the difference of the distance of the needle tip to the nerve at similar current intensities but different pulse widths (100 vs

1000 μsec) in 20 sciatic nerve blocks using Labat's approach. They concluded that successful nerve blocks can be placed at 0.3 mA with a pulse width of 100 μ seconds.

14. The Sensitivity of Motor Responses for Detecting Catheter-Nerve Contact During Ultrasound-Guided Femoral Nerve Blocks with Stimulating Catheters[57]

Fernando Altermatt et al determined the sensitivity of motor response evoked by stimulating catheters while performing femoral nerve block using catheter – nerve contact in ultrasound image as reference. They observed that the current required to elicit motor response ranged from 0.18 to 2.0 mA. The sensitivity of motor response to nerve stimulation was 64%. They concluded that the absence of motor response at current less than 0.5 mA does not indicate absence of needle nerve contact.

15. An evaluation of the brachial plexus block at the humeral canal using a neurostimulator (1417 patients): the efficacy, safety, and predictive criteria of failure.[58]

Carles M et al evaluated the safety and efficacy of multiple peripheral nerve blocks at humeral canal with the use of a nerve stimulator in 1417 patients. The success rate with block of all four nerve territories with absence of other anaesthetic technique supplementation was 95%. The threshold of nerve stimulation for ulnar nerve was 0.7mA, for radial nerve was 0.6mA and for median nerves was 0.8 mA respectively. Failure rates were more when currents higher than this were used.

16. 1,001 Subclavian Perivascular Brachial Plexus Blocks: Success with a Nerve Stimulator.[59]

Carlo D. Franco et al prospectively gathered data from 1001 subclavian perivascular blocks performed at the Cook County Hospital over 2.5 years. All blocks were performed by Winnie's technique using nerve stimulator instead of paraesthesia with a volume of 35 to 40 ml of local anaesthetic solution.

The blocks were all performed either by the authors or residents under the supervision of the authors. 97.2% blocks (973) were completely successful, 1.6% (16 blocks) were incomplete and required supplementation and only 1.2% (12 blocks) failed completely and required general anaesthesia.

They concluded that nerve stimulator guided technique was successful and safe for surgery on the upper extremity. There was no occurrence of pneumothorax or any other major complications.

17. Brachial Plexus Block, a Comparison of Nerve Locator versus Paraesthesia Technique[60]

Nitin Sathyan et al compared nerve locator and paraesthesia technique for supraclavicular block in 50 patients using 20 ml of 0.5% ropivacaine solution.

They found that the onset of sensory block was lesser in nerve locator group (10 to 15 minutes) than in paraesthesia group(11 to 15 minutes). The

onset time for motor block was similar in both groups at 19.44 minutes and 17.72 minutes in paraesthesia and nerve locator groups respectively.

Duration of block was 4.79 hours in paraesthesia group and 5.04 hours in nerve locator group. Paraesthesia group had the higher incidence of multiple punctures with five cases of block failure requiring general anaesthesia.

They concluded that nerve locator technique is safe and better compared to paraesthesia technique.

18. A comparative study of nerve stimulator versus ultrasound-guided supraclavicular brachial plexus block[61]

Mithun Duncan et al, compared nerve stimulator and ultrasound guidance for supraclavicular brachial plexus block. 60 patients were randomly divided into two groups and received 1:1 mixture of 0.5% bupivacaine and 2% lignocaine with 1:2,00,000 adrenaline.

They concluded that there was no statistically significant difference in both the groups with respect to block execution time, success rate and onset time for sensory and motor block.

19. Supraclavicular brachial plexus block with and without Dexamethasone – A Comparative Study[62]

Pathak et al conducted a study to compare the effect of adding dexamethsone in nerve stimulator guided supraclavicular block. They selected 50 patients and randomly divided them into two groups to receive local anaesthetic mixture alone or with dexamethasine. They found that the mean

onset of sensory and motor block was 6.7±2.9 and 16.6±5.2 minutes in the group without dexamethasone and in the group with dexamethasone, the onset time for sensory and motor block was 6.02±28 and 16±5.6 minutes. The duration of analgesia was 834±78.1 minutes and 276±38.73 minutes in the groups with and without dexamethasone respectively.

They concluded that dexamethasone is a safe and cost effective adjuvant for supraclavicular block.

MATERIALS AND METHODS

This study was a prospective randomized double blinded trial. In this study, 60 patients from the Department of Plastic Surgery and Department of Orthopaedics, Chengalpattu Medical College Hospital were analysed. The study was conducted over a period of one year after obtaining Institutional Ethical Committee approval.

Patients who were posted for elective upper limb surgery below elbow in the age group of 16 – 60 years belonging to ASA grade I and II of either sex were counselled about the purpose of study. The procedure was explained to the patient in their own language. Informed written consent was obtained.

Patients who fulfilled the inclusion criteria and those who gave consent were then randomly allocated to one of the study groups based on computerized randomized list.

INCLUSION CRITERIA:

i. Age 16 to 60 years

ii. ASA class I and II patients

iii. Patients posted for elective upper limb surgeries below elbow.

EXCLUSION CRITERIA:

i. Age < 16 years

ii. ASA class III & IV

iii. Infection at the puncture site

iv. Patients refusal

v. Patients with hypersensitivity to lignocaine

vi. Coagulopathy

vii. Peripheral neuropathy

viii. Pregnancy

ix. Surgery in both upper limbs in same sitting.

x. Anticipated difficult intubation.

MATERIALS REQUIRED:

1. Peripheral nerve stimulator / locator (Inmed equipments Nerve locator/mapper NM 20) with electrical cables having clearly marked polarity at both ends with button or alligator clip for grounding electrode.

2. Autoclavable 5 cm long 22G insulated bevelled (Braun Stimuplex) nerve stimulator needles.

3. Disposable ECG electrodes for attaching to patient skin.

4. 10 ml sterile disposable syringes.

5. Hypodermic disposable needles 26 G.

6. Bowl, Sponge holding forceps, sterile gauze pieces, sterile towel, Povidone Iodine solution.

7. Sterile gown, Gloves, Cap & Mask

8. Local anaesthetic solution – 15 ml of 2% Lignocaine with 1 : 2,00,000 adrenaline and 15 ml of 0.5% bupivacaine

9. Boyle's apparatus and oxygen cylinder

10. Emergency kit with working laryngoscope, endotracheal tubes of appropriate sizes, airways, working suction apparatus with suction catheter.

11. Emergency drugs: Inj. Adrenaline, Inj. Atropine, Inj.Thiopentone , Inj.Succinylcholine, 20% intralipid.

13. Monitor for continuous monitoring of Pulse Rate, Oxygen saturation, Non-invasive blood pressure, ECG, Respiratory rate.

NEEDLE USED FOR PERFORMING THE BLOCK

NERVE STIMULATOR USED FOR PERFORMING THE BLOCK

METHODOLOGY

60 patients of ASA I and II scheduled to undergo elective upper limb surgery below elbow were included in the study. Patients underwent thorough preoperative evaluation which included detailed history, physical examination & investigations (Haemoglobin, PCV, platelet count, bleeding time, clotting time, urine albumin & sugar, blood urea, serum creatinine, serum electrolytes, random blood sugar, Chest X ray and ECG).

Written informed consent was obtained from all patients included in the study. On the day of surgery, patients were wheeled into the theatre and then connected to a multipara monitor showing PR, SpO_2, NIBP, continuous ECG and respiratory rate.

After obtaining basal vital parameters, the planned procedure was explained again to the patients in their own language. An 18G intravenous

cannula was inserted into one of the hand or forearm veins of the patient's non operated upper limb and an infusion of 500 ml Ringer's lactate solution was started as per perioperative fluid requirement calculation.

Intradermal sensitivity testing for lignocaine and bupivacaine were performed in all patients with 0.1 ml of each agent. Patients were then premedicated with Inj. Glycopyrrolate 0.2 mg, Inj. Midazolam 0.01 mg/kg and Inj. Fentanyl 1µg/kg intravenously.

TECHNIQUE – **subclavian perivascular approach**

Patient was placed supine with the head turned away from the side to be blocked. The arm to be blocked was adducted with the shoulder pulled down, the forearm supinated if possible and hand was kept as close to the ipsilateral knee as possible. A rolled towel was placed between the shoulders along the spine to increase exposure of the area.

Under strict aseptic precautions, skin above and below the clavicle was disinfected and draped. With the help of an assistant, the nerve stimulator was connected with the electrical cable which in turn was attached to the needle (cathodal end) and to the patient (grounding anodal end).

Subclavian artery was palpated 1 to 2 cm above the clavicle in the interscalene groove. A skin wheal was raised at the intended site of needle entry with 0.5 ml of 2% lignocaine using a 26G hypodermic needle. A 22G bevelled insulated needle of 5 cm length was then inserted just cephaloposterior to the artery perpendicular to the skin surface. If the rib was

contacted, anteroposterior needle adjustment with careful medial and lateral probing was done to locate the plexus.

The different nerve responses included the following muscle contractions:

- ✓ Pectoralis, deltoid, biceps (upper trunk)
- ✓ Triceps, forearm (upper, middle trunk)
- ✓ Hand, fingers (lower trunk)

Response from the lower trunk, which is twitching of fingers or hand in flexion or extension was the desired response. Following which, the needle was fixed and after negative aspiration for blood each time, the local anaesthetic mixture of 15 ml of 2% Lignocaine with 1: 2,00,000 adrenaline plus 15 ml of 0.5% bupivacaine was injected in 5 ml increments. Visual and verbal contact was maintained with the patient during and after injection. Patients were monitored closely for complications of the block and local anaesthetic systemic toxicity. Based on computerised randomization, patients were given supraclavicular block in the following method:

In Group A (0.5 mA), the nerve stimulator was initially set to deliver a current of 0.9 mA. After obtaining twitch of hand or fingers in flexion or extension, the current strength was gradually reduced till response was similarly obtained with 0.5 mA. Then the needle was fixed and the drug was injected through the extension catheter (de aired before the injection) by the assistant.

In Group B (0.9 mA), the nerve stimulator was initially set to deliver a current of 0.9 mA. After obtaining twitch of hand or fingers in flexion or extension, the needle was fixed and the drug was injected through the extension catheter (de aired before the injection) by the assistant.

Following the block, the patients were taken over by an anaesthesiologist who was blinded to the grouping. Continuous vitals monitoring with regular assessment of the block was then performed by the blinded anaesthesiologist.

Surgery was allowed to commence after 20 minutes only on confirmation of adequate and complete blockade. Insufficient blockade was planned to be supplemented with general anaesthesia according to our institution protocol and such cases were to be excluded from the study.

The following parameters were noted by the blinded anaesthesiologist intra operatively and post operatively:

- **Duration of surgery**

  From the beginning of skin incision to skin closure.

- **No. of attempts to perform the block**

  An attempt is defined as needle entry into the site for block till the appropriate motor response was observed.

- **Time taken to perform the block**

From the time of skin disinfection, till the end of local anaesthetic injection.

- **Time of onset of sensory blockade**

From the time of completion of local anaesthetic injection (time zero), sensory blockade was assessed by pin prick in radial, median and ulnar nerve territories (dorsal surface of thumb, palmar surfaces of index and little fingers respectively) for every 2 minutes till 20 minutes. Onset time was calculated when patients experienced no response to pin prick in all three territories irrespective of whichever nerve was blocked first.

- **Total duration of sensory blockade**

Time interval between onset of sensory blockade to the time when patient first experienced touch sensation in any of the three territories in the hand blocked.

- **Time of onset of motor blockade**

From the time of completion of local anaesthetic injection (time zero), motor blockade was assessed for every 2 minutes in the hand using Hollmen scale[63]:

Grade 1 – normal motor function.

Grade 2 – weak motor function.

Grade 3 – very weak motor function.

Grade 4 – complete loss of motor function.

Attaining Grade 2 was considered as onset of motor blockade.

- **Total duration of motor blockade**

Time interval between onset of motor blockade to the time when patient was able to move any finger in the hand blocked.

- **Time taken for Rescue analgesia**

Time interval between onset of sensory blockade to the time when patient experienced pain sensation in the surgical site. Analgesia was provided with Inj. Diclofenac 75 mg intramuscularly.

- **Complications** (if any).

STATISTICAL ANALYSIS

The statistical analysis was done using SPSS (Statistical package for social sciences) version 16 for windows. Quantitative data are presented as mean ± 1SD. Bar and line diagrams are drawn as and when required. Chi square test for association is used for comparison of categorical variables between the two groups. Quantitative analysis was compared using Student's't' test. A 'p' value of < 0.05 obtained by two tailed analysis was considered statistically significant.

OBSERVATION AND RESULTS

The study comprised of two groups. The patients were selected by computer generated random numbers.

GROUP A

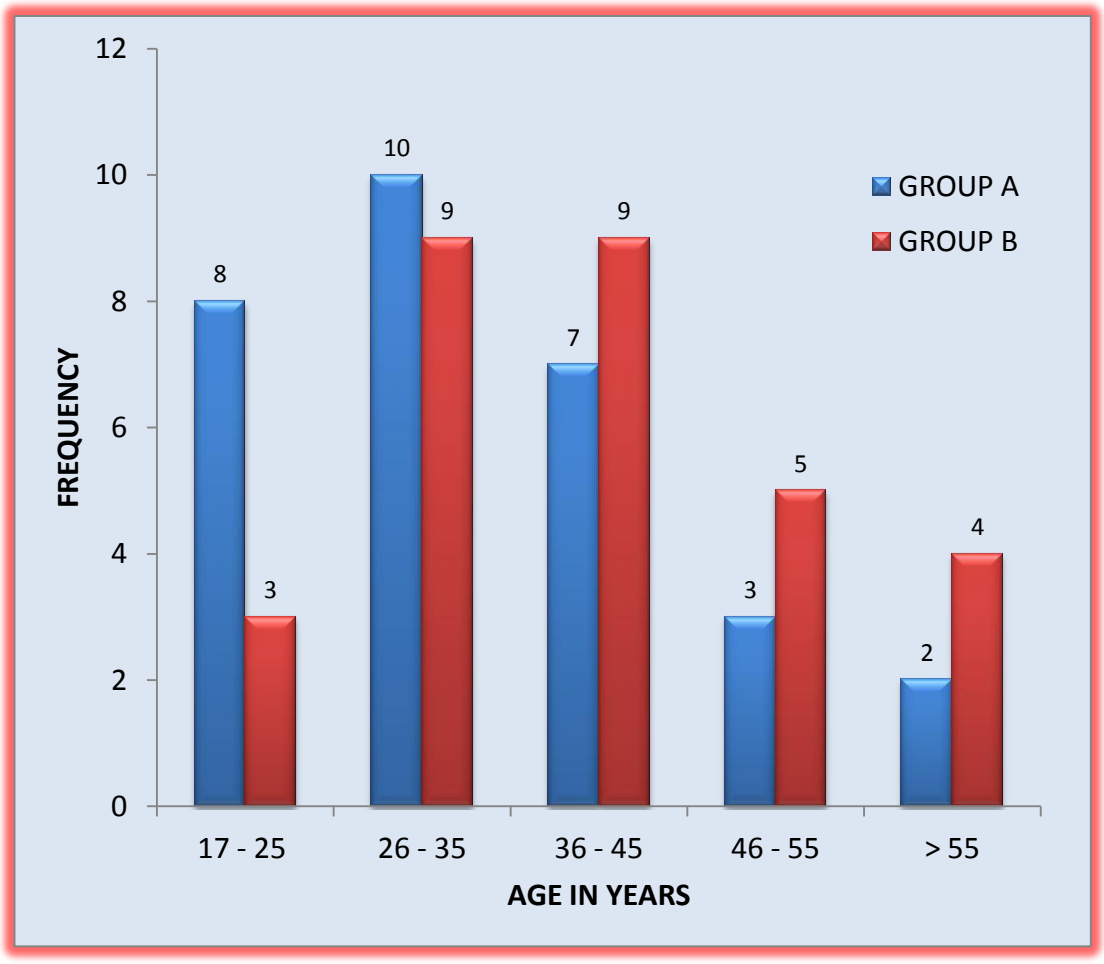
30 patients received supraclavicular block at a current strength of 0.5 mA.

GROUP B

30 patients received supraclavicular block at a current strength of 0.9 mA. The patient characteristics like age, weight and sex were noted. The outcomes measured were duration of surgery, no. of attempts to perform the block and time taken to perform the block, onset time for sensory and motor blockade, duration of sensory and motor blockade, time taken for rescue analgesia and complications if any.

I. AGE DISTRIBUTION

Age distribution in Group A (0.5 mA) varied from 17 to 59 years with a mean of 33.57 years and a standard deviation of 11.717 years. In Group B (0.9 mA), age varied from 17 to 60 years with a mean of 39.03 years and a standard deviation of 11.924 years. The difference between the groups was statistically insignificant as shown in graph 1 and table 1 (p value of 0.078).



GRAPH 1 - AGE DISTRIBUTION

TABLE 1- AGE DISTRIBUTION

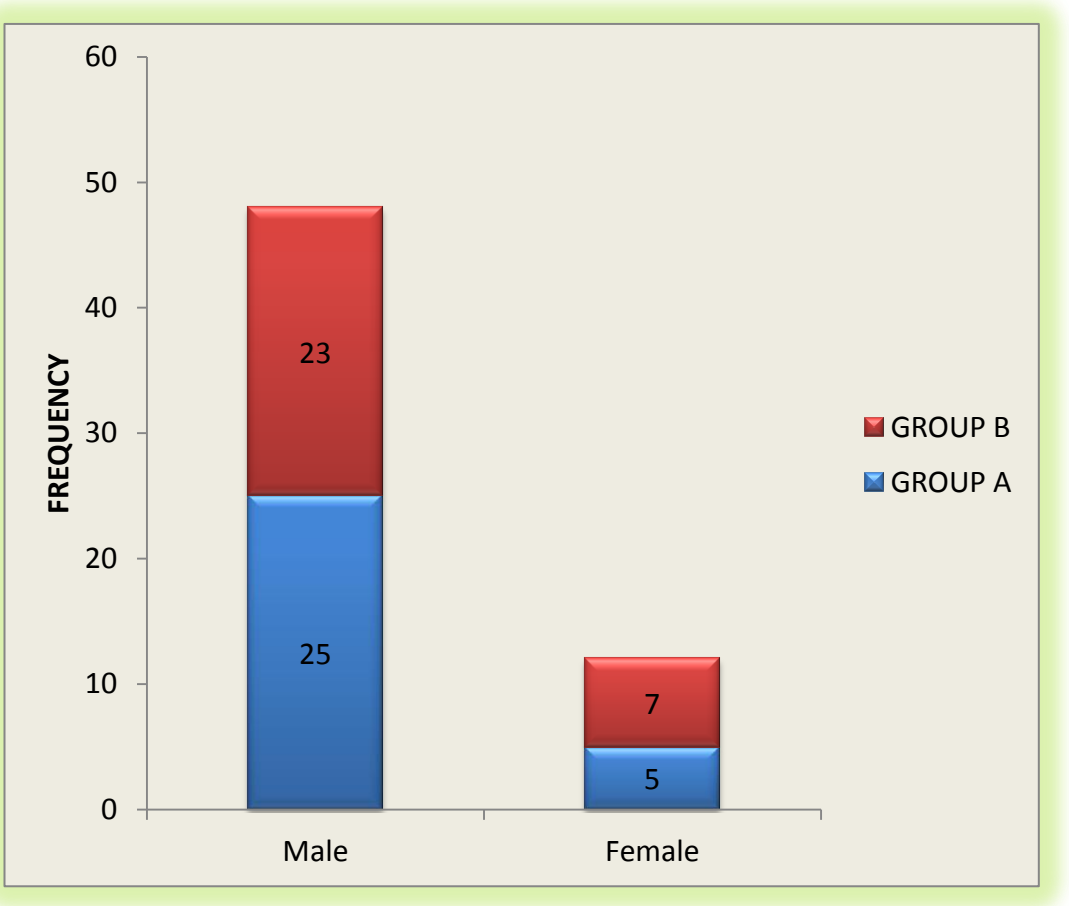
AGE GROUPS	**GROUP A**		**GROUP B**	
	NO.	**%**	**NO.**	**%**
17 – 25 years	8	26.67	3	10
25 – 35 years	10	33.33	9	30
35 – 45 years	7	23.33	9	30
45 – 55 years	3	10	5	16.67
> 55 years	2	6.67	4	13.33
Total	30	100	30	100
Range Mean S.D.	17 – 59 33.57 11.717		17 - 60 39.03 11.924	
t p	1.791 **0.78** (not significant)			

II. SEX DISTRIBUTION

Group A included 25 males and 5 females and Group B included 23 males and 7 females with chi square value of 0.41 and p value of 0.5 which was statistically insignificant. Shown in table 2 and graph 2.

TABLE 2- SEX DISTRIBUTION

GROUP	MALE	FEMALE	TOTAL	CHI SQUARE VALUE	p
A	25	5	30	0.41	**0.5**
B	23	7	30		



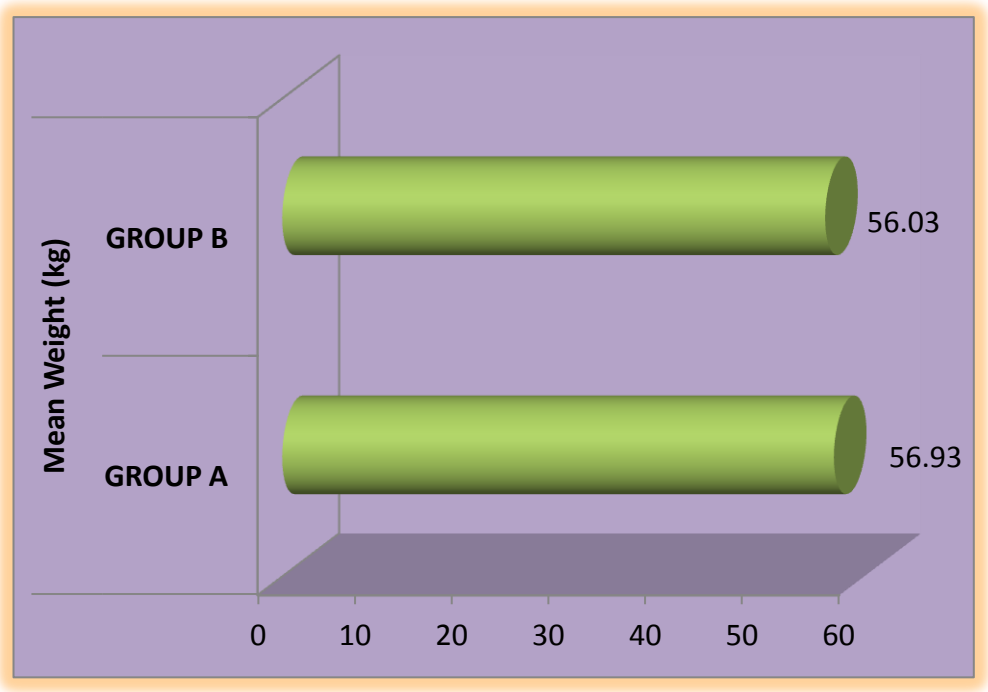
GRAPH 2 - SEX DISTRIBUTION

III. WEIGHT DISTRIBUTION

Weight distribution in Group A ranged from 45 to 72 kilograms with a mean and standard deviation of 56.93 and 6.908 kilograms respectively. In Group B, weight ranged from 42 to 66 kilograms with a mean and standard deviation of 56.03 and 6.189 kilograms respectively. The p value of 0.597 was statistically not significant as shown in table 3 and graph 3.

TABLE 3- WEIGHT DISTRIBUTION

GROUP	N	MEAN (kg)	STD DEVIATION (kg)	t	p
A	30	56.93	6.908	0.531	**0.597**
B	30	56.03	6.189		



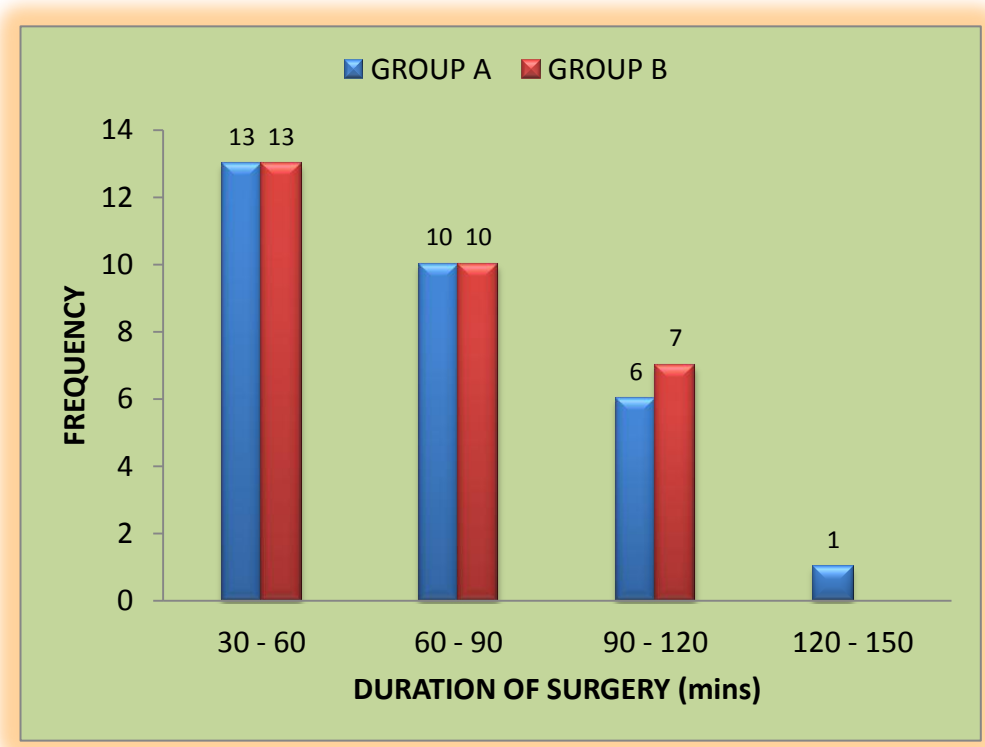
GRAPH 3 - WEIGHT DISTRIBUTION

IV. DURATION OF SURGERY

The duration of surgery ranged from 40 to 125 minutes in Group A with a mean of 70.67 minutes and standard deviation of 26.351 minutes. On the other hand, duration in Group B ranged from 35 to 120 minutes with a mean of 72.5 minutes and standard deviation of 26.677 minutes. The p value of 0.79 was statistically insignificant as shown in table 4 and graph 4.

TABLE 4 – DURATION OF SURGERY

GROUP	N	MEAN (minutes)	STD DEVIATION (minutes)	t	p
A	30	70.67	26.351	0.268	**0.79**
B	30	72.5	26.677		



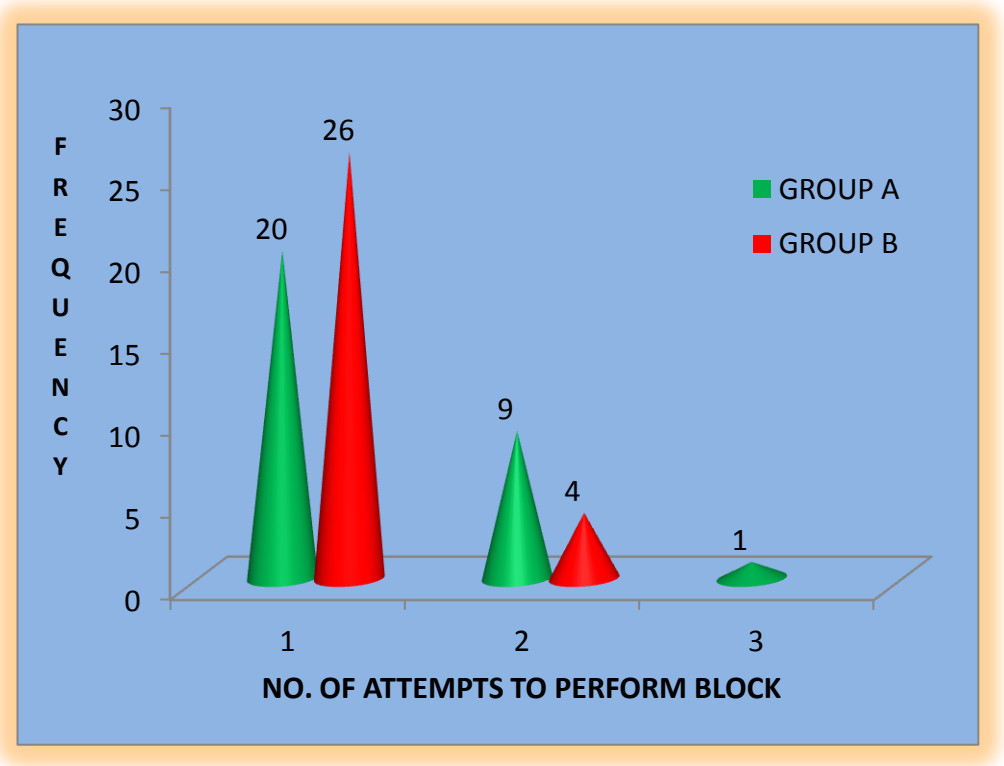
GRAPH 4 - DURATION OF SURGERY

V. NO. OF ATTEMPTS TO PERFORM BLOCK

In Group A, the blocks were performed in 1 to 3 attempts with a mean of 1.37 and standard deviation of 0.556. In Group B, the blocks were performed in 1 or 2 attempts with a mean of 1.13 and standard deviation of 0.346. Though the mean duration was less in Group B, it was not statistically significant (p value of 0.056) as shown in table 5 and graph 5.

TABLE 5 - NO. OF ATTEMPTS TO PERFORM BLOCK

GROUP	N	MEAN	STD DEVIATION	t	P
A	30	1.37	0.556	1.952	**0.056**
B	30	1.13	0.346		



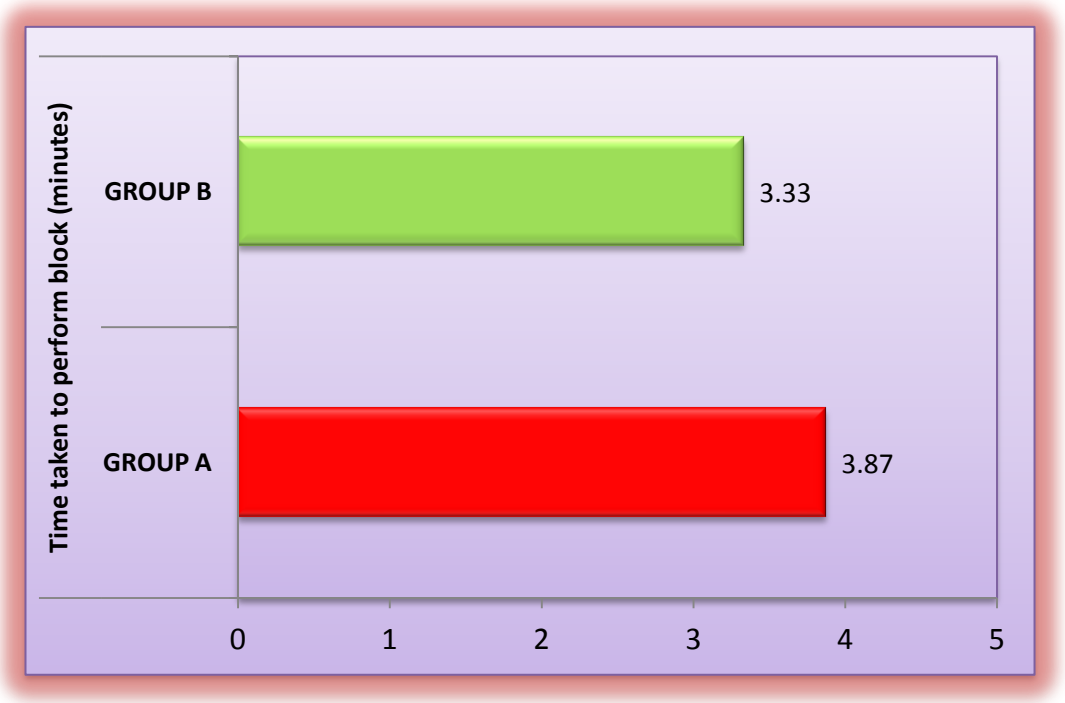
GRAPH 5 - NO. OF ATTEMPTS TO PERFORM BLOCK

VI . TIME TAKEN TO PERFORM THE BLOCK

The blocks were performed in Group A and B in a mean duration of 3.87 and 3.33 minutes with a standard deviation of 1.224 and 0.844 minutes respectively. Though the mean duration was less in Group B (0.9 mA), the difference was statistically insignificant (p value of 0.054) as shown in table 6 and graph 6.

TABLE 6 - TIME TAKEN TO PERFORM THE BLOCK

GROUP	N	MEAN (minutes)	STD DEVIATION (minutes)	t	p
A	30	3.87	1.224	1.964	**0.054**
B	30	3.33	0.844		



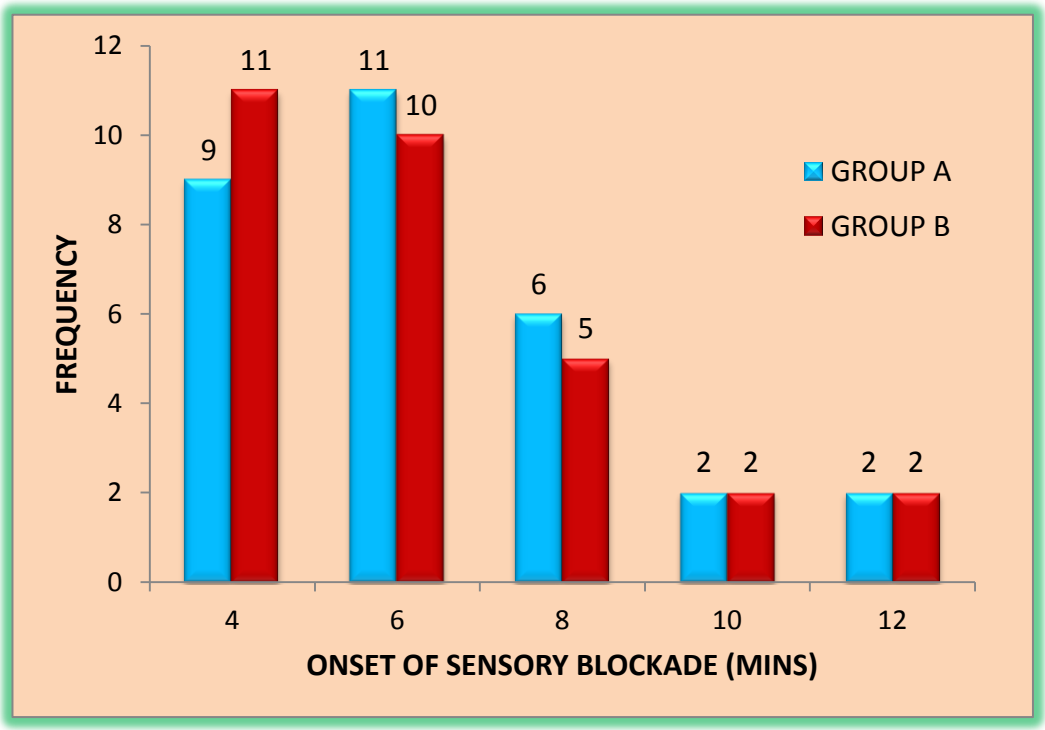
GRAPH 6 - TIME TAKEN TO PERFORM THE BLOCK

VII. ONSET OF SENSORY BLOCKADE

In Group A, onset time for sensory blockade ranged from 4 to 12 minutes with a mean of 6.47 ± 2.33 minutes. In Group B, onset time for sensory blockade ranged from 4 to 12 minutes with a mean of 6.27 ± 2.33 minutes. The p value was 0.083 which was statistically insignificant as shown in table 7 and graph 7.

TABLE 7 - ONSET OF SENSORY BLOCKADE

GROUP	N	MEAN (minutes)	STD DEVIATION (minutes)	t	p
A	30	6.47	2.33	1.762	**0.083**
B	30	6.27	2.33		



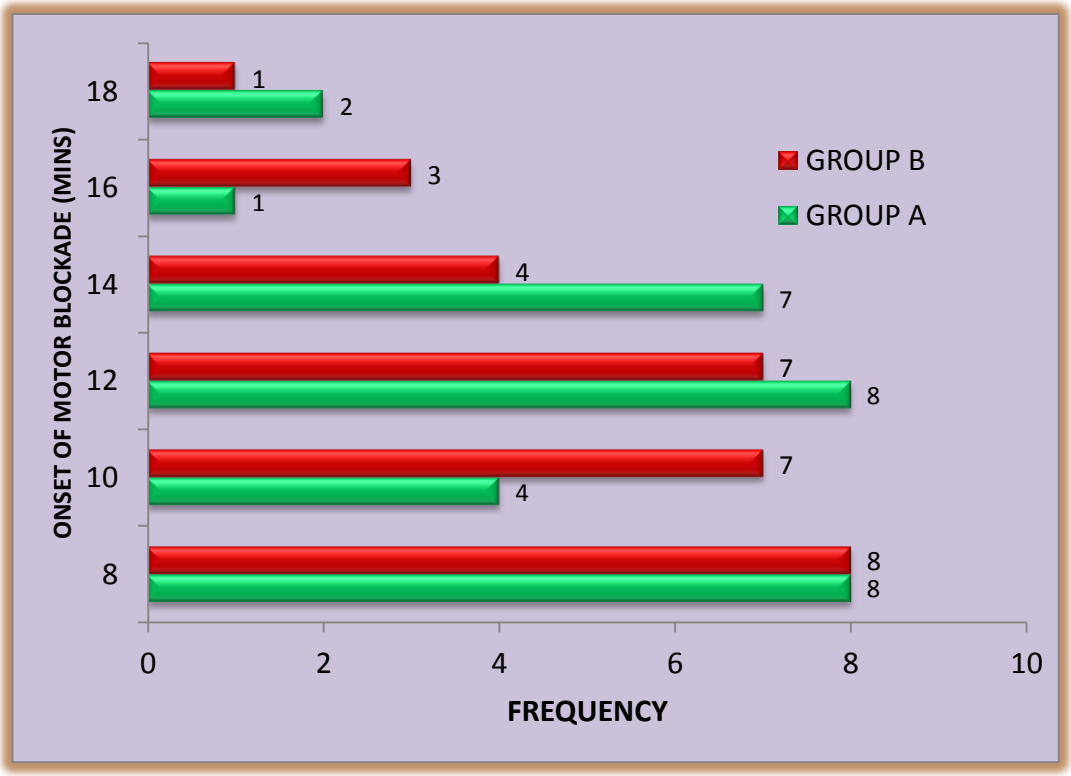
GRAPH 7 - ONSET OF SENSORY BLOCKADE

VIII. ONSET OF MOTOR BLOCKADE

In Group A, onset time for motor blockade ranged from 8 to 18 minutes with a mean of 11.67 ± 2.975 minutes. In Group B, onset time for motor blockade ranged from 8 to 18 minutes with a mean of 11.33 ± 2.893 minutes. The p value was 0.057 which was statistically insignificant as shown in table 8 and graph 8.

TABLE 8 - ONSET OF MOTOR BLOCKADE

GROUP	N	MEAN (minutes)	STD DEVIATION (minutes)	t	p
A	30	11.67	2.975	1.940	**0.057**
B	30	11.33	2.893		



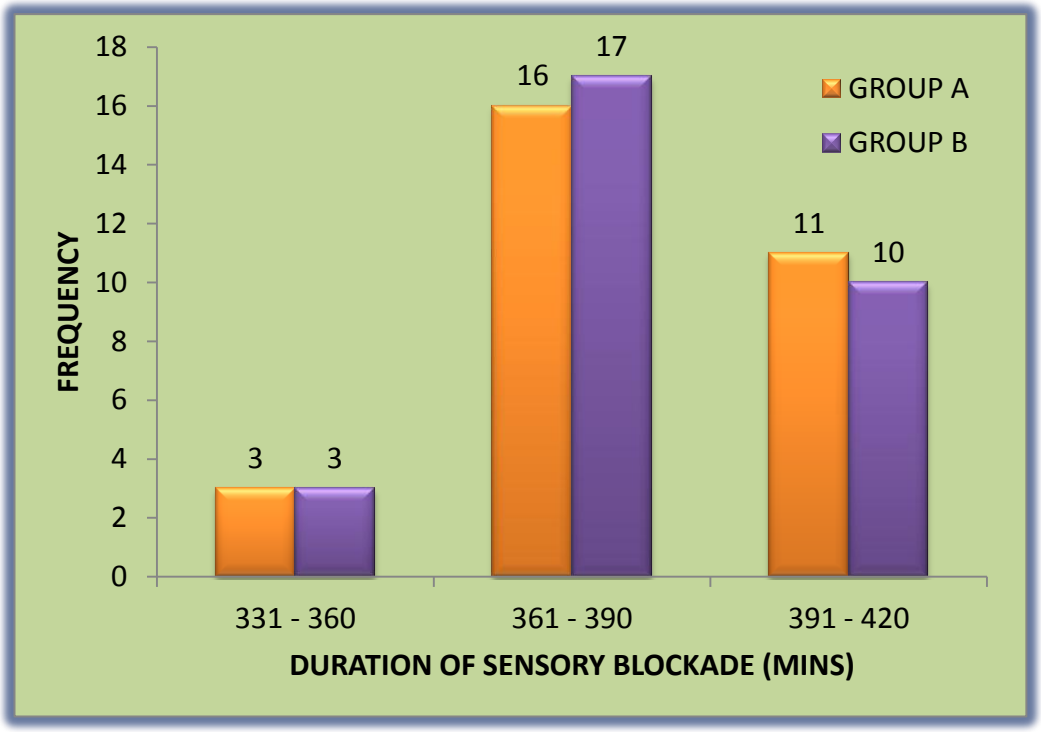
GRAPH 8 - ONSET OF MOTOR BLOCKADE

IX. DURATION OF SENSORY BLOCKADE

In Group A, duration of sensory blockade ranged from 350 to 420 minutes with a mean of 390.33 ± 18.659 minutes. In Group B, duration of sensory blockade ranged from 340 to 420 minutes (B) with a mean of 390 ± 19.493 minutes. The p value was 0.712 which was statistically insignificant as shown in table 9 and graph 9.

TABLE 9 - DURATION OF SENSORY BLOCKADE

GROUP	N	MEAN (minutes)	STD DEVIATION (minutes)	t	p
A	30	390.33	18.659	0.370	**0.712**
B	30	390	19.493		



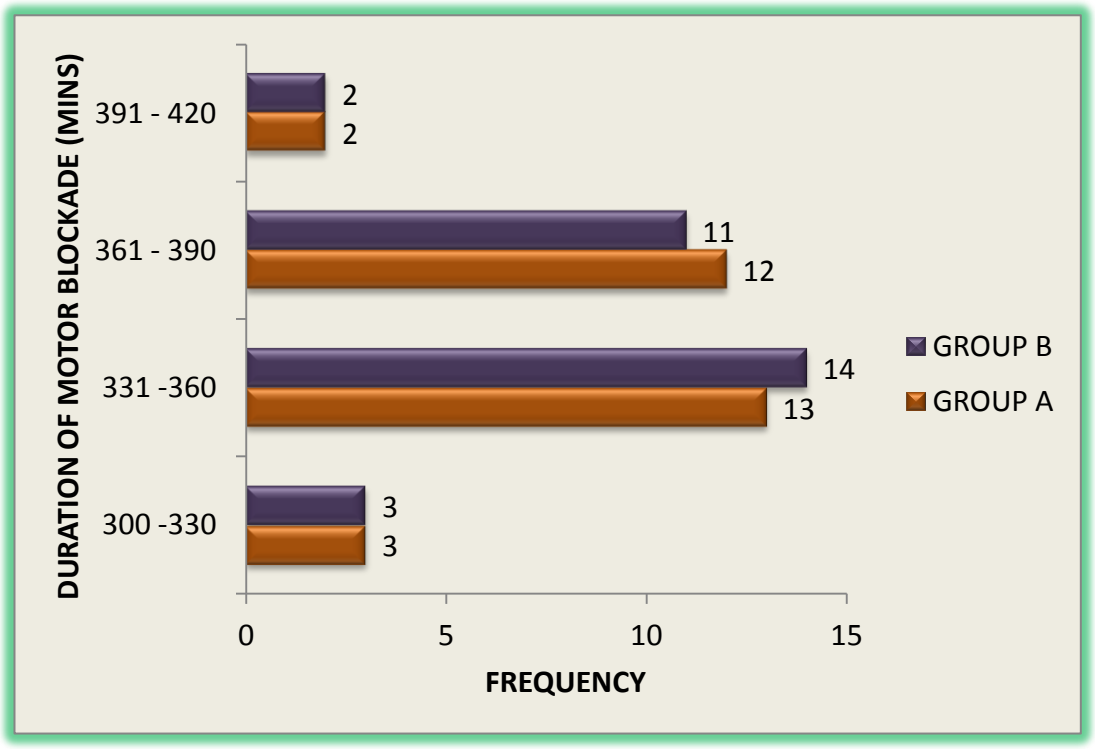
GRAPH 9 - DURATION OF SENSORY BLOCKADE

X. DURATION OF MOTOR BLOCKADE

In Group A, duration of motor blockade ranged from 330 to 400 minutes with a mean of 364.33 ± 19.357 minutes. In Group B, duration of motor blockade ranged from 300 to 400 minutes with a mean of 364.33 ± 23.589 minutes. The p value was 0.522 which was statistically insignificant as shown in table 10 and graph 10.

TABLE 10 - DURATION OF MOTOR BLOCKADE

GROUP	N	MEAN (minutes)	STD DEVIATION (minutes)	t	p
A	30	363.33	19.357	0.644	**0.522**
B	30	364.33	23.589		



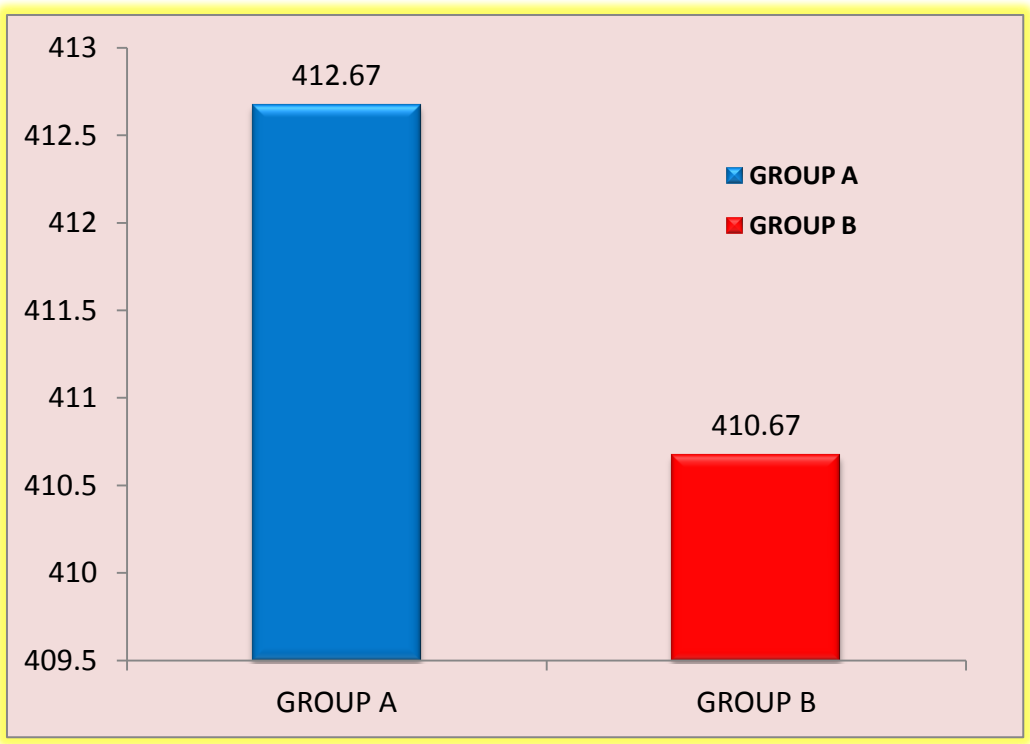
GRAPH 10 - DURATION OF MOTOR BLOCKADE

XI. TIME FOR RESCUE ANALGESIA

Rescue analgesia was provided for patients in Group A in a mean duration of 412.67 ± 18.742 minutes and for patients in Group B in a mean duration of 410.67 ± 22.118 minutes. The p value was 0.110 which was statistically insignificant as shown in table 11 and graph 11.

TABLE 11 - TIME FOR RESCUE ANALGESIA

GROUP	N	MEAN (minutes)	STD DEVIATION (minutes)	t	p
A	30	412.67	18.742	1.622	**0.110**
B	30	410.67	22.118		



GRAPH 11 - TIME FOR RESCUE ANALGESIA

DISCUSSION

In our study, supraclavicular block performed at two different current strengths 0f 0.5 and 0.9 mA using nerve stimulator were compared. The idea behind the study was that, if blocks performed at the seeking current of 0.9 mA after obtaining definite motor response were similar to those performed after reducing the current strength to 0.5 mA, then there would be no need for unnecessary needle manipulations.

The rate of complications due to needle manipulations and needle passes can also be significantly reduced. The time taken to complete the block will also reduce if blocks are performed at the seeking current. In our study, it was found that the two groups showed no statistically significant difference.

Statistical analysis between the two groups showed no significant difference with regard to demographic data like age, sex and weight with a ‘p’ value of 0.078, 0.5 and 0.597 respectively. Hence, both groups were comparable in relation to age, sex and weight.

DURATION OF SURGERY

The duration of surgery was 70.67±26.351 minutes in Group A and 72.5±26.677 minutes in Group B with a ‘p’ value of 0.79 which was statistically insignificant.

NUMBER OF ATTEMPTS TO PERFORM BLOCK

The number of attempts to perform block was 1.37±0.556 in Group A and 1.13±0.346 minutes in Group B with a 'p' value of 0.056 which was statistically insignificant.

TIME TAKEN TO PERFORM BLOCK

The time taken to perform block was 3.87±1.224 minutes in Group A and 3.33±0.844 minutes in Group B with a 'p' value of 0.054 which was statistically insignificant.

ONSET OF SENSORY BLOCKADE

The onset of sensory blockade was 6.47±2.33 minutes in Group A and 6.36±2.438 minutes in Group B with a 'p' value of 0.862 which was statistically insignificant comparable to the study by **Carlo Franco et al**[45].

The onset time was comparable to the study by **Mithun Duncan et al**[61] which compared nerve stimulator with ultrasound guided block and found the sensory onset time to be 5.90 ± 1.85 minutes in nerve stimulator group. The onset time was also comparable to the study by **Pathak et al**[62] in which sensory block onset was in 6.7 ± 2.9 minutes.

ONSET OF MOTOR BLOCKADE

The onset of motor blockade was 11.67±2.975 minutes in Group A and 11±2.694 minutes in Group B with a 'p' value of 0.376 which was statistically insignificant. The onset of motor blockade followed the onset of sensory blockade which was comparable to the study by **Chan et al**.[64]

DURATION OF SENSORY BLOCKADE

The duration of sensory blockade was 390.33±18.659 minutes in Group A and 390.36±20.454 minutes in Group B with a 'p' value of 0.996 which was statistically insignificant.

DURATION OF MOTOR BLOCKADE

The duration of motor blockade was 363.33±19.357 minutes in Group A and 364.64±24.416 minutes in Group B with a 'p' value of 0.821 which was statistically insignificant.

TIME FOR FIRST RESCUE ANALGESIA

The time for first rescue analgesia was 412.67±18.742 minutes in Group A and 410.36±22.849 minutes in Group B with a 'p' value of 0.675 which was statistically insignificant. The duration of analgesia was comparable to the study by **Mithun Duncan et al**[61] in which the duration of analgesia in nerve stimulator group was 401.13±105.65 minutes.

COMPLICATIONS

There were no complications in both the groups. The success rate in both groups at 0.5 and 0.9 mA was 100% comparable to the study by **Carlo Franco et al.**

LIMITATIONS OF THE STUDY

- All patients belonged to ASA I and II.
- Smaller sample size.

CONCLUSION

From our study, it is clearly inferred that supraclavicular block performed at 0.5 and 0.9 mA using nerve stimulator for upper limb surgeries below elbow is comparable in terms of attempts at block performance, time taken to perform block, onset of block and duration of block. The success rate was 100 % with no complications in both groups.

Hence, nerve stimulator guided blocks may be performed at the initial seeking current itself (< 1 mA) to avoid multiple attempts and unnecessary needle manipulations which may prove harmful to the patient.

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LIST OF ABBREVIATIONS

mA	–	milliamperes.
ml	–	millilitres.
kg	–	kilograms.
µg	–	micrograms.
ASA	–	American society of Anaesthesiologists.
PR	–	Pulse Rate.
SpO_2	–	Oxygen saturation.
NIBP	–	Non Invasive Blood Pressure
ECG	-	Electrocardiogram
psi	–	pounds per square inch

PROFORMA

- Name :
- Age /sex:
- IP no :
- Date of admission :
- Date of surgery :
- Address for communication:
- Contact no:
- Diagnosis :
- Surgery :
- Weight :
- PR:
- BP:
- CVS:
- RS:
- ABDOMEN:
- CNS:
- Mallampati classification class:
- ASA PS class :
- Investigations :
  - ✓ Hb:
  - ✓ TC

- ✓ DC
- ✓ Platelets
- ✓ RFT:
- ✓ Urine routine:
- ✓ ECG:
- ✓ CXR:
- ✓ Electrolytes:
- ✓ Others :

❖ Premedication :

❖ Current strength used for supraclavicular block :

❖ Drugs given :

❖ Time taken to perform the block:

❖ No. of attempts to perform the block:

❖ Time of onset of sensory block:

❖ Time taken for onset of motor blockade:

❖ Total duration of sensory block:

❖ Duration of motor block:

❖ Time of first rescue analgesia given:

❖ Other side effects:

MASTER CHART
GROUP A – 0.5 mA

S.NO.	Name	Age	Sex	Ip no	Weight (kg)	Duration of surgery (mins)	No of attempts to perform block	Time taken to perform block (mins)	Onset of sensory blockade (mins)	Onset of motor blockade (mins)	Duration of sensory blockade (mins)	Duration of motor blockade (mins)	Time for first rescue analgesia (mins)	Compli cations
1	VENKATESAN	27	M	40869	62	95	1	5	8	12	390	370	410	NIL
2	POOVARASAN	19	M	41209	57	80	1	3	6	12	420	380	440	NIL
3	KARTHICK	24	M	40918	59	120	3	7	6	14	400	370	420	NIL
4	NANDHAGOPAL	59	M	39780	53	65	1	4	8	14	380	350	410	NIL
5	KARTHICK KUMAR	19	M	42336	49	45	1	3	6	10	390	360	420	NIL
6	CHANDRAN	38	M	44267	61	50	1	3	4	8	380	350	420	NIL
7	MUTHAMMAL	58	F	44965	49	40	2	6	8	14	380	360	430	NIL
8	YOGAN	42	M	47974	58	75	1	3	10	12	390	360	400	NIL
9	AMALA	23	F	46371	48	55	2	4	12	18	410	380	420	NIL
10	MANIKANDAN	17	M	50294	64	45	2	5	6	14	370	340	390	NIL
11	PRABHU	34	M	50896	48	100	1	4	4	8	380	350	430	NIL
12	SIVAPRAKASAM	27	M	783	67	110	1	3	6	10	380	350	410	NIL
13	KARTHIK	22	M	774	68	55	1	3	6	8	400	370	410	NIL
14	RAJESH	26	M	4193	57	75	1	3	4	12	420	400	440	NIL
15	DHANAPAL	36	M	6743	45	125	1	3	4	8	390	360	400	NIL

16	KRISHNAN	37	M	27568	59	40	1	3	4	12	410	390	420	NIL
17	MANI	30	M	33078	47	50	1	2	6	10	390	370	420	NIL
18	MURALI	25	M	36758	54	65	1	3	6	14	380	350	410	NIL
19	NAVALAN	50	M	37532	53	100	1	3	4	8	400	360	420	NIL
20	ILAYAKUMARAN	25	M	39769	56	40	1	3	8	14	420	390	430	NIL
21	SUNDARI	53	F	40635	50	55	2	5	10	16	360	330	380	NIL
22	NAGARAJ	26	M	41612	58	40	1	3	8	12	380	360	390	NIL
23	KANNIYAPPAN	38	M	41912	62	80	2	5	6	12	420	400	440	NIL
24	VIJAYAKUMAR	26	M	48253	58	75	2	6	12	18	410	370	430	NIL
25	KUMAR	40	M	41565	53	65	1	2	6	14	400	380	410	NIL
26	RAJAVENI	50	F	43843	66	110	1	4	8	12	360	330	380	NIL
27	SHIVA	27	M	17841	52	45	2	4	4	8	370	340	410	NIL
28	MARIYAMMAL	35	F	17942	65	90	2	5	6	10	350	330	360	NIL
29	MURUGAN	45	M	18023	58	90	2	5	4	8	390	380	410	NIL
30	SATHYAPRAKASH	29	M	17361	72	40	1	4	4	8	390	370	420	NIL

GROUP B – 0.9 mA

S.no.	Name	Age	Sex	Ip no	Weight (kg)	Duration of surgery (mins)	No of attempts to perform block	Time taken to perform block (mins)	Onset of sensory blockade (mins)	Onset of motor blockade (mins)	Duration of sensory blockade (mins)	Duration of motor blockade (mins)	Time for first rescue analgesia (mins)	Compli cations
1	SHENBAGAVALLI	35	F	44728	49	45	1	3	6	12	390	360	420	NIL
2	ANJALI	42	F	46082	50	40	1	2	4	12	410	370	430	NIL
3	ANDAL	40	F	44964	52	35	1	2	4	10	390	380	430	NIL
4	FATHIMA	38	F	44980	45	45	1	3	4	12	420	390	440	NIL
5	KOCHADAIYAN	36	M	1188	61	60	1	2	4	8	380	360	410	NIL
6	VENKATACHALAM	33	M	4980	60	75	1	3	6	12	390	360	420	NIL
7	VELU	55	M	5435	66	85	1	3	4	8	380	360	390	NIL
8	ARUMUGAM	17	M	6624	59	90	1	3	6	8	400	390	420	NIL
9	SIVAPRAKASAM	27	M	783	42	50	1	3	8	14	410	380	430	NIL
10	VENKATESAN	20	M	9362	45	55	1	3	10	14	390	350	420	NIL
11	BASKAR	31	M	51910	56	85	2	5	8	14	380	360	410	NIL
12	PRABHU	30	M	50896	56	45	1	4	6	10	340	300	350	NIL
13	VIJAYAKUMAR	26	M	48253	56	110	1	2	6	12	380	360	400	NIL
14	JAGADISAN	40	M	48375	66	105	1	3	4	10	360	320	370	NIL
15	BACKIYAM	38	F	42674	52	120	1	4	6	12	410	380	420	NIL

16	UDAYAKUMAR	24	M	42705	54	85	1	3	8	14	380	360	400	NIL
17	PACHAIYAPPAN	60	M	41463	66	65	1	4	8	16	420	400	430	NIL
18	SUBRAMANI	60	M	3793	59	45	1	3	6	10	410	390	420	NIL
19	THANGARAJ	60	M	50796	57	80	1	3	4	8	350	320	360	NIL
20	KANAGU	40	F	22666	57	45	1	3	4	8	380	340	400	NIL
21	UDAYAKUMAR	58	M	929	62	65	2	5	10	16	380	360	420	NIL
22	ARUMUGAM	43	M	1893	56	55	1	3	6	8	390	360	400	NIL
23	ARULPRAKASAM	32	M	2169	60	45	2	5	12	16	410	390	420	NIL
24	SARAVANAN	30	M	5782	57	100	1	3	4	8	390	370	420	NIL
25	MANOHARAN	47	M	5887	59	80	1	4	4	10	380	360	410	NIL
26	MURUGAN	39	M	6847	62	110	1	4	6	10	420	400	450	NIL
27	NATARAJAN	48	M	18548	52	80	1	4	12	18	390	350	420	NIL
28	SARAVANAN	48	M	18821	51	120	1	4	8	10	410	390	420	NIL
29	SHIVA	27	M	17891	52	45	1	3	6	12	370	350	390	NIL
30	SAGUNTHALA	47	F	21240	62	110	2	4	4	8	390	370	400	NIL

CONSENT FORM

We are conducting a Study on **"Comparison Between Two Different Current Strengths for Supraclavicular Block Using Nerve Stimulator In Elective Upper Limb Surgeries Below Elbow"**. The purpose of the study is to find whether reduction in current strength is needed to improve the quality of block while using the nerve stimulator. The privacy of the patient in the research will be maintained throughout the study. In the event of any publication or presentation resulting from the research, no personally identifiable information will be shared.

Taking part in the study is voluntary- You are free to decide whether to participate in this study or to withdraw at any time. Your decision will not result in any loss of benefits to which you are otherwise entitled.

The results of the special study may be intimated to you at the end of the study period or during the study if anything is found abnormal which may aid in the management or treatment.

Signature of investigator Signature of patient /guardian

Date:

ஆராய்ச்சி ஒப்புதல் கடிதம்

ஆராய்ச்சி தலைப்பு

செங்கல்பட்டு அரசு பொது மருத்துவமனையில் இரு வேறு மின் அளவுகளில் நரம்பு தூண்டுதல் கருவியின் மூலம் கழுத்து பட்டை எலும்பின் மேல் வழங்கப்படும் நரம்பு மறுத்தல் முறை பற்றிய ஒப்பிட்டு ஆய்வு.

ஆய்வாளர்கள்:

Dr. காஞ்சனா P.G., Dr. பாஸ்கர் M.D.,

இடம்:

செங்கல்பட்டு மருத்துவக் கல்லூரி மருத்துவமனை.

திரு/திருமதி _____

_____

என்ற விலாசத்தில் வசிக்கும் நான் எனக்கு அளிக்கப்பட்ட தகவல் படிவத்தில் உள்ள விஷயங்களை படித்தும் கேட்டும் புரிந்துக் கொண்டேன்.

இந்த ஆய்விற்கு தேவையான பரிசோதனைகளுக்கு உட்பட சம்மதிக்கிறேன்.

இந்த ஆராய்ச்சியில் பிறரின் நிர்பந்தமின்றி என் சொந்த விருப்பத்தின் பேரில் நான் பங்கு பெறுகிறேன்.

ஆய்வில் தொடர்ந்து பங்கு பெற விருப்பமில்லை என்றால் விலகி கொள்ளலாம் என்றும் அறிந்துக் கொண்டேன்.

ஆய்வின் முடிவினை சொந்த அடையாளங்களை வெளியிடாமல் பயன்படுத்திக் கொள்ள சம்மதிக்கிறேன்.

நோயாளியின் பெயர்:	கையொப்பம்	நாள்
நடுநிலை சான்றாளரின் பெயர்	கையொப்பம்	நாள்
ஆராய்ச்சியாளரின் பெயர்	கையொப்பம்	நாள்